REPORT RESUMES

ED 019 238 SE 003 939

REORGANIZED SCIENCE CURRICULUM, 5B, FIFTH GRADE SUPPLEMENT.
MINNEAPOLIS SPECIAL SCHOOL DISTRICT NO. 1, MINN.
EDRS PRICE MF-$0.75 HC-$7.00 173P.

DESCRIPTORS- *BIBLIOGRAPHIES, *CURRICULUM DEVELOPMENT, *CURRICULUM, *GRADE 5, *TEACHING GUIDES, ASTRONOMY, BIOLOGY, EARTH SCIENCE, PHYSICAL SCIENCES, SCIENCE EQUIPMENT, SCIENCE MATERIALS, SCIENCE ACTIVITIES, SCIENCE COURSES, MINNEAPOLIS, MINNESOTA,

THE EIGHTH IN A SERIES OF 17 VOLUMES, THIS VOLUME PROVIDES THE FIFTH GRADE TEACHER WITH A GUIDE TO THE REORGANIZED SCIENCE CURRICULUM OF THE MINNEAPOLIS PUBLIC SCHOOLS. THE MATERIALS ARE AUGMENTED AND REVISED AS THE NEED ARISES. THE FIFTH GRADE SUPPLEMENT IS IN TWO PARTS. CONTAINED IN 5A ARE THE INTRODUCTORY MATERIAL, THE CONCEPTS SECTION, AND THE RESOURCE UNITS SECTION. RESOURCE UNITS ARE INCLUDED FOR HEAT AND THE UNIVERSE. THIS VOLUME, 5B, CONTAINS THE SECTIONS ENTITLED (1) BIBLIOGRAPHY, BOOKS, (2) BIBLIOGRAPHY, FILMS, AND (3) EQUIPMENT AND SUPPLIES. (DH)

SE003 939

ED019238

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

For discussion purposes only

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

A SELECTIVE BIBLIOGRAPHY

of

BOOKS FOUND USEFUL

in the

TEACHING OF THE SCIENCE UNITS

for
Grade Five

Correlated to the Major Topics as found in the
Reorganized Science Curriculum

Minneapolis Public Schools
Science Department
8-24-64

For discussion purposes only

Grade Five

TABLE OF CONTENTS

Major Topics	Page	Color
Introduction to Science		
C. Methods	1	Gray
I. The Earth		
G. Weather and climate	3	Pink
II. Living Things		
A. Life and life processes	6	Green
B. Classification	8	Green
E. Human body	10	Green
III. Energy		
B. Sources and conservation of energy	11	Yellow
G. Electrical energy	12	Yellow
I. Heat and infrared radiation	14	Yellow
IV. The Universe		
A. Earth	16	Blue
B. Moon	17	Blue
D. Solar system	18	Blue
E. Stars and galaxies	20	Blue

The annotations for books found on the following pages were obtained from many bibliographies which were consulted in the preparation of this list.

Introduction to Science

C. Methods	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Barret, Raymond E. 1963 BUILD IT YOURSELF SCIENCE LABORATORY * Doubleday. $4.50 This fully illustrated book tells you how to build 200 pieces of useful science equipment out of inexpensive materials for experiments and observations in chemistry, physics, and biology as well as in astronomy, geology, and meteorology.	X		Good		
Beeler, Nelson F. and Branley, F. M. 1947 EXPERIMENTS IN SCIENCE * Crowell. $2.95 Home experiments with simple materials. Clear directions and illustrations.	X		Average	Average	Average
Beeler, Nelson F. and Branley, F. M. 1957 EXPERIMENTS WITH A MICROSCOPE ** Crowell. $3.50 Practical research ideas in many fields, and advice on the care and use of the microscope.	X	X	Good	Good	

* Good
** Excellent

Introduction to Science - C. (continued)

	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Beeler, Nelson F. and Branley, F. M. 1950 MORE EXPERIMENTS IN SCIENCE ** Crowell. $2.95 Experiments with simple ingredients that give answers to many questions about helicopters, telegraph, stethoscopes, refrigerators and numerous other things.	X		Good		
Van Atta, Frieda E. 1962 HOW TO HELP YOUR CHILD IN GRADE SCHOOL SCIENCE * Random. $5.95 Grade-by-grade guide for parents prepared by teacher.	X		Good	Average	Average
Vergara, William C. 1958 SCIENCE IN EVERYDAY THINGS * Harper. $4.95 Answers to hundreds of interesting and scientific questions.	X				

* Good
** Excellent

For discussion
purposes only

Grade Five

Introduction to Science

A. Attitudes (including history)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Gourlay, Walter E. 1963 PICTURE BOOK OF TODAY'S SCIENTISTS * Sterling $1.99 In short accounts, each illustrated by a photograph, the author presents 25 contemporary research scientists whose greatest achievements have taken place within the last ten years. He combines very brief biographical information with a concise explanation of their discoveries, or fields of research, including such men as Libby, Seaborg, Woodward, Pauling, Salk, Von Braun, and Van Allen, as well as others less well known.				Average	Difficult

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5 Addition to Page 2
(Addendum)

Introduction to Science

C. Methods	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Cooper, Elizabeth K. 1958 SCIENCE IN YOUR OWN BACKYARD ** Harcourt $3.00 Simple experiments involving soil and rocks, fossils, water, grasses, flowers, plants, birds, insects, animals, clouds, weather and stars.			Good	Good	Average

* Good
** Excellent

I. The Earth

G. Weather and Climate	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Feravolo, Rocco V. 1963 JR. SCIENCE BOOK OF WEATHER EXPERIMENTS ** Garrard. $2.50 Gives many weather experiments and directions for making instruments.		X	Good	Good	Easy
Gallant, Roy A. 1957 EXPLORING THE WEATHER ** Garden City. $2.50 An attractive and informative book about the weather, with many pictures and diagrams in color.	X	X		Good	Average
Hitte, Kathryn. HURRICANES, TORNADOES AND BLIZZARDS * Random House. $2.19 The raging, destructive storms that affect all mankind.			Average	Average	Easy
Knight, David C. 1961 THE FIRST BOOK OF AIR * Watts. $2.50 Contains air experiments for the young reader to do.	X		Good	Average	Average

* Good
** Excellent

I. The Earth - G. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Larrick, Nancy. 1961 RAIN, HAIL, SLEET AND SNOW * Garrard Press. $1.00 A first reader on meteorology, accurate, with simple vocabulary.		X		Good	Easy
McGrath, Thomas. 1959 CLOUDS * Melmont. $2.50 An elementary explanation of the various kinds of clouds and what they mean weatherwise, presented in attractive pictures and very brief text. Good for delayed readers.		X		Average	Easy
Neurath, Marie. 1960 BETWEEN EARTH AND SKY * Sterling. $2.69 Good for slow readers. The simple text and lively Isotype illustrations show what causes such things as hurricanes, tornadoes and hailstorms--why the sky is red at night--how lightning strikes--the reasons for shooting stars.		X		Good	Easy
Spilhaus, Athelstan F. 1951 WEATHERCRAFT ** Viking. $2.00 Presents instructions for constructing, operating, and maintaining important weather instruments.	X		Good	Average	Average

* Good
** Excellent

I. The Earth - G. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Wyler, Rose. 1956 THE FIRST BOOK OF WEATHER ** Watts. $2.50 The origins and causes of various types of weather. Simple experiments and directions for making weather instruments and maps.		X	Good	Average	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade Four
(Addendum)

Addition to
Page 5

I. The Earth

A. History

	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Watson, Jane Werner 1960 THE GIANT GOLDEN BOOK OF DINOSAURS AND OTHER PREHISTORIC REPTILES ** Golden Press $3.39 Dramatic pictures and text introduce young people to many of the creatures of prehistoric times.	X	X		Good	Average to Difficult

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 5

I. The Earth

G. Weather and Climate	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Adler, Irving 1959 WEATHER IN YOUR LIFE ** Day $3.50 Includes weather phenomena, their causes and effects, weather forecasting. Also discusses briefly man's efforts to control the weather. Illustrated with drawings, photographs and diagrams.		X		Good	Average to Difficult
Bonsall, George (Blackwood, Paul E., Ed.) 1960 THE HOW AND WHY BOOK OF WEATHER ** Grosset $1.00 Answers basic questions about the weather, emphasizing experiments.			Good	Good	Average
Forrester, Frank 1957 1001 QUESTIONS ANSWERED ABOUT THE WEATHER ** Dodd $6.00 Discusses weather conditions of various countries of the world, and the influence of weather upon certain historical events.	X	X	Good		

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5 (Addendum)

Addition to Page 5

I. The Earth - G. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Spar, Jerome 1957 THE WAY OF THE WEATHER ** Creative Educational Soc. $7.50 A magnificently illustrated introduction to weather, air and climate.	X	X		Good	Average
Waller, Leslie 1959 A BOOK TO BEGIN ON WEATHER ** Holt $2.50 Tells the how and why of weather for the very young reader.		X	Good	Good	Easy

* Good
** Excellent

II. Living Things

A. Life and life processes	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Barker, Will. 1956 FAMILIAR ANIMALS OF AMERICA ** Harper. $4.95 A well-written, authoritative guide to the subject.	X	X			
Farb, Peter and the Editors of Life. 1964 THE FOREST ** Silver Burdett. This is a splendid reference book on forests. The illustrations are excellent.	X	X		Good	Average to Difficult
Glemser, Bernard. 1958 ALL ABOUT THE HUMAN BODY ** Random. $1.95 An excellent and simple anatomy and physiology book with good diagrams.	X	X		Average	Average
Jordan, E. L. 1952 HAMMOND'S NATURE ATLAS OF AMERICA ** Hammond. $4.95 Information on the plants and animals to be found in this country.	X	X			

* Good
** Excellent

II. Living Things - A. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
McClung, Robert M. 1958 ALL ABOUT ANIMALS AND THEIR YOUNG * Random. $1.95 How different kinds of animals reproduce and care for their young. Includes examples of "simple" animals as well as insects, birds and mammals.				Good	Average
Selsam, Millicent E. 1953 MICROBES AT WORK * Morrow. $2.78 What microbes are and how they affect our lives. A readable text with easy experiments for the reader.		X	Good	Average	Average
Williamson, Margaret. 1949 THE FIRST BOOK OF BUGS * Watts. $2.50 An introduction to many kinds of insects. Food for slow readers.				Average	Easy

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 7

II. Living Things

A. Life and life processes	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Collins, Henry Hill Jr. 1962 JUNIOR SCIENCE BOOK OF TURTLES * Garrard $2.25 Strange facts about big turtles and little turtles, turtle eggs, and turtle babies are graphically described.			Average	Good	Easy
Heavilin, Jay 1964 BEES AND WASPS ** Macmillan Co. $2.04 A book of colorful pictures and excellent descriptions of the work and life habits of different kinds of bees and wasps.		X	Average	Good	Easy
Nasca, Donald, Glenn Sprague 1964 FLASHING FINS * F. A. Owen Pub. Co. $1.90 After winning a fishing contest, Fred studies the world beneath the waves, learning unusual and interesting facts of fish, their lives and habits.				Good	Difficult

* Good
** Excellent

II. Living Things

B. Classification	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Barker, Will. 1956 FAMILIAR ANIMALS OF AMERICA ** Harper. $4.95 A well-written, authoritative guide to the subject.	X	X			
Cormack, Maribelle B. 1951 THE FIRST BOOK OF TREES * Watts. $2.50 An introduction to differentiating characteristics of trees. Includes sections on the many uses to which trees are put, and information on conservation.	X	X		Average	Average
Hogner, Dorothy Childs. 1958 THE ANIMAL BOOK * Walck. $5.75 Scientific classification of various mammals found north of the Rio Grande.	X	X		Good	Average
Jordan, E. L. 1952 HAMMOND'S NATURE ATLAS OF AMERICA ** Hammond. $4.95 Information on the plants and animals to be found in this country.	X	X			

* Good
** Excellent

II. Living Things - B. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Sterling, Dorothy. 1955 THE STORY OF MOSSES, FERNS, AND MUSHROOMS * Doubleday. $2.75 Introduces the student to flowerless plants and gives detailed descriptions of various species for easy identification. Good illustrations.		X		Average	Average
Williamson, Margaret. 1957 THE FIRST BOOK OF MAMMALS ** Watts. $2.50 Scientific descriptions of many of these creatures.		X		Good	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY .. Grade 5 Addition to
(Addendum) Page 9

II. Living Things

B. Classification	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Fenton, Carroll Lane and Dorothy C. Pallas 1957 TREES AND THEIR WORLD ** Day $3.50 Discusses sap; deciduous and coniferous trees; growth; seeds; and the effect of seasons on trees.	X	X		Good	Average
Headstrom, Richard 1964 ADVENTURES WITH FRESHWATER ANIMALS ** Lippincott $4.25 Describes dozens of exploratory adventures and close observations of small life forms such as protozoa, tadpoles, blackflies, leeches and copepods.	X				
Lemmon, Robert S. 1962 JUNIOR SCIENCE BOOK OF BIG CATS * Garrard $2.25 An easy-to-read introductory book about the characteristics, food, habitat and behavior of the big cats and similarities between the big cats and lesser cats.			Average	Good	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 9

II. Living Things - B. (Continued)	Tchr Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Nasca, Donald & Glenn Sprague 1964 ALOFT ON WINGS ** F. A. Owen Pub. Co. $1.90 Finding a wounded chickadee leads Cathy to discover more about birds, their lives, bodies, feathers, eggs, and method of flight. Major species are studied as well as ways to aid conservation.			Good	Good	Average to Difficult
Rush, Hanniford 1964 BACKYARD BIRDS * Macmillan Co. $2.04 This book contains colorful pictures and excellent descriptions of the common birds that visit our backyards.		X		Good	Easy
Shuttlesworth, Dorothy and Su Zan Noguchi Swain 1964 THE STORY OF ANTS ** Doubleday $3.25 An excellent and attractively illustrated book about the characteristics and behavior of ants and a description of the ant colony.		X	Good	Good	Difficult

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 9

II Living Things - B. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Shuttlesworth, Dorothy 196[illegible] THE AGE OF REPTILES ** Doubleday $3.00 A vividly illustrated book about dinosaurs and other reptiles; explains how scientists preserve and study the remains of these prehistoric animals.	X	X		Good	Difficult
Uhl, Melvin John ABOUT SOME ANIMALS THAT WORK FOR MAN * Melmont $2.50 This book explores the entire subject of the animals that work for man from the aardvark to the zebu.		X		Good	Easy

* Good
** Excellent

II. Living Things

E. Human body	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Ravielli, Anthony. 1954 WONDERS OF THE HUMAN BODY. * Viking. $2.62 Describes the skeleton, muscles, central nervous system, heart, lungs, and the digestive system.	X	X		Good	Average

* Good
** Excellent

III. Energy

B. Sources and conservation of energy

	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Bendick, Jeanne. 1961 LIGHTNING * Rand McNally. $2.95 Beginning with myths and superstitions, tells children what lightning really is, with lively illustrations.		X		Average	Average
Branley, Franklyn M. 1957 SOLAR ENERGY * Crowell. $3.50 Informed speculation about the future uses of energy from the sun.		X	Average	Average	Average to Difficult
Kadesch, Dr. Robert R. 1961 THE CRAZY CANTILEVER ** Harper. $3.95 Fascinating and informative experiments easily performed with readily available materials. Designed to provide practice in careful observation, sound experimentation, and clear thinking.	X		Good	Average	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 11

III. Energy

B. Sources and conservation of energy	Tchr. Ref	Illus.	Learning Activities	Pupil Interest	Reading Level
Hogben, Lancelot 1957 THE WONDERFUL WORLD OF ENERGY ** Doubleday $2.95 Relates man's harnessing of the energy of nature: falling water, the heat of the sun, air pressure, wind, natural fuels, and the atom.	X	X	Average	Good	Difficult
Irving, Robert 1958 ENERGY AND POWER ** Knopf $3.19 Defines energy and power, explores the various forms and sources of energy, and tells how man has harnessed and put it to use.		X	Average	Good	Average
Ruchlis, Hy 1961 THE WONDER OF HEAT ENERGY ** Harper $3.79 The third in a series of physics books for children. Basic principles are described accurately and authoritatively, together with diverse practical applications.	X				

* Good
** Excellent

III. Energy

G. Electrical Energy	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Epstein, Sam and Beryl. 1953 THE FIRST BOOK OF ELECTRICITY ** Watts. $2.50 The nature and uses of electricity are discussed.		X	Good	Good	Average
Feravolo, Rocco V. 1960 JR. SCIENCE BOOK OF ELECTRICITY * Garrard. $2.25 Basic principles and uses of static and current electricity are explained through simple experiments that a child can do himself.		X	Good	Average	Easy
Kadesch, Dr. Robert R. 1961 THE CRAZY CANTILEVER ** Harper. $3.95 Fascinating and informative experiments easily performed with readily available materials. Designed to provide practice in careful observation, sound experimentation, and clear thinking.	X	X	Good	Average	Average

* Good
** Excellent

III. Energy - G. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Miers, Earl Schenck. 1959 THE STORYBOOK OF SCIENCE ** Rand. $2.95 The eight areas included are electricity, electronics, heat, food, wheels, the sky, the universe and the atomic age.				Average	Average
Polgreen, John and Cathy. 1963 THUNDER AND LIGHTNING * Doubleday. $1.50	X	X	Good	Good	Easy

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 3

III. Energy

G. Electrical Energy	Tchr. Ref.	Illus	Learning Activities	Pupil Interest	Reading Level
Edison, Thomas Alva (Foundation) 1960 EDISON EXPERIMENTS YOU CAN DO * Harper $2.92 A biographical sketch of Thomas Alva Edison introduces this book of experiments derived from Edison's own notebooks. Clear directions are given for experiments related to his inventions: the carbon button, telespecan, insulation, electric light, fuse, wireless, radio tube, electric pen, phonograph, and quadruplex. Materials needed for each experiment, easily obtainable at home, or in the neighborhood drug store or hardware store, are listed by chapters on the end of the book.		X	Average	Good	Easy
Freeman, Mae and Ira 1961 THE STORY OF ELECTRICITY ** Random House $1.95 For young boys and girls.		X	Good	Good	Easy
Reuben, Gabriel 1961 ELECTRONICS FOR CHILDREN ** Sterling $2.95 A book of safe experiments using simple equipment in the fields of magnetism, electricity, electronics and nuclear energy.		X	Good	Good	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 13

III. Energy - G. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Yates, Raymond F. 1959 A BOY AND A BATTERY ** Harper $2.92 This revised edition of the original 1942 book contains such additional information as: How to make a thermoelectric cell; The solar battery; The atomic battery.	X	X	Good	Good	Average

* Good
** Excellent

III. Energy

I. Heat and Infrared Radiation

	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Beeler, Nelson and Franklyn Branley. 1949 EXPERIMENTS WITH ELECTRICITY ** Crowell. $2.95 Includes scientific explanations of each intriguing experiment.		X	Good	Average	Average
Feravolo, Rocco V. 1964 JR. SCIENCE BOOK OF HEAT ** Garrard. $2.50 Simple demonstrations and experiments.			Good	Good	Average
Herbert, Don and Ruchlis, Hy. 1960 BEGINNING SCIENCE WITH MR. WIZARD: HEAT ** Doubleday. Any child will have many absorbing hours reading and doing as he learns what heat is, how heat travels around inside his house, how heat makes engines go, and how heat cooks his food.		X	Good	Average	Average

* Good
** Excellent

III. Energy - I. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Kadesch, Dr. Robert R. 1961 THE CRAZY CANTILEVEL ** Harper. $3.95 Fascinating and informative experiments easily performed with readily available materials. Designed to provide practice in careful observation, sound experimentation, and clear thinking.	X	X	Good	Average	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 15

XII. Energy

I. Heat and Infrared Radiation	Tchr Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Buehr, Walter 1961 WONDER WORKER: THE STORY OF ELECTRICITY ** Morrow $3.00 For boys and girls.		X	Good	Good	Easy
Freeman, Ira M. 1957 ALL ABOUT ELECTRICITY ** Random $2.37 Presents the basic principles of electrical power.			Average	Average	Average
Notkin, Jerome J. & Gulkin, Sidney 1960 HOW AND WHY BOOK OF ELECTRICITY ** Grosset $1.00 Shows children how to find answers experimentally to elementary questions about electricity.		X	Good	Good	Average
Tannenbaum, Harold and Stillman, Nathan 1960 FIRE AND HOW IT IS USED ** Webster 69¢ This book contains a concise explanation of fire, its uses and control. A good resource for teaching fire safety.			Good	Good	Easy

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 15

III. Energy - I. (continued)	Tchr Ref.	Illus	Learning Activities	Pupil Interest	Reading Level
Yates, Raymond F. 1944 A BOY AND A MOTOR ** Harper $2.75 Clear instructions and diagrams are included to make this an excellent book in elementary electrical engineering.		X	Good	Good	Average

* Good
** Excellent

IV. The Universe

A. Earth	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Schloat, G. Warren. 1958 ANDY'S WONDERFUL TELESCOPE * Scribner. $2.91 Explains in photographs the principles of reflecting and refracting telescopes. Introduces the solar system and the constellations.		X	Good	Good	Average

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade
(Addendum)

Addition to
Page 16

IV. The Universe

A. Earth	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Gallant, Roy 1956 EXPLORING THE UNIVERSE ** Doubleday $2.95 Explains theories about the origin and organization of the universe.	X	X	Good		Difficult
Zim, Herbert S. 1961 THE UNIVERSE ** Morrow $2.75 Simple account of complex subject written for the young reader.		X		Good	Easy

* Good
** Excellent

IV. The Universe

B. Moon

	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Branley, Franklyn M. 1960 THE MOON: EARTH'S NATURAL SATELLITE ** Crowell. $3.50 Discusses the moon's motions, pull, temperature, atmosphere, and man's instruments for measuring these. For young people.	X	X		Good	Difficult

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 17

IV. The Universe

B. Moon	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Binder, Otto 1959 THE MOON: OUR NEIGHBORING WORLD * Golden Press $1.69 Easy-to-read science book for boys and girls.	X				
Gallant, Roy 1955 EXPLORING THE MOON ** Doubleday $2.50 Many questions will arise in the minds of the readers when reading this account of the moon, its wonders, craters, mountains, etc.	X	X	Good		Difficult

* Good
** Excellent

IV. The Universe

C. Sun	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Gallant, Roy 1958 EXPLORING THE SUN ** Doubleday $2.50 This book presents a history of the study of the sun and explains the studies of the sun being carried out today.	X	X	Good		Difficult
Zim, Herbert S. 1953 THE SUN ** Morrow $2.78 A fascinating view of the sun telling of its production of heat and light, its size as compared to other stars, and its composition.	X	X	Good	Good	Average

* Good
** Excellent

IV. The Universe

D. Solar System	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Binder, Otto. 1960 PLANETS: OTHER WORLDS OF OUR SOLAR SYSTEM ** Golden Press. $1.69 Factual information for young people.	X	X		Good	Average
Branley, Franklyn M. MARS, PLANET NUMBER FOUR ** Crowell. $3.50 For young people. %	X	X			
Branley, Franklyn M. 1958 THE NINE PLANETS: EXPLORING OUR UNIVERSE ** Crowell. $3.50 This book contains descriptive information about all the planets in the solar system. It includes an explanation of how scientists procure this information.	X	X		Good	Average to Difficult
Munch, Theodore. 1959 WHAT IS A SOLAR SYSTEM * Benefic. $1.80 An excellent presentation of the six types of bodies that comprise our solar system--sun, planets, moons, planetoids, comets and meteors.		X		Good	Easy

* Good
** Excellent

IV. The Universe - D. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Stoiko, Michael and Donald Cox. 1959 MAN------IN THE UNIVERSE: WHAT YOU SHOULD KNOW ABOUT OUR SOLAR SYSTEM ** Winston. $2.95 For young people.		X		Good	Difficult
Tellander, Marian. 1961 SPACE * Follett. $1.00 Beginner's book about our solar system.		X	Good	Average	Easy

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5 (Addendum)

Addition to Page 19

IV. The Universe

D. Solar System	Tchr Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Chamberlain, Joseph Miles and Thomas D. Nicholson 1957 PLANETS, STARS, AND SPACE ** Creative Educational Soc. $7.50 An overall perspective on celestial objects, from the earth to the outer galaxies.	X	X			Difficult
Clark, Mary Lou 1965 YOU AND RELATIVITY ** Childrens Press $2.50 Non-mathematical introduction to relativity. From the simple question "What is up?", the book invites a young reader to stretch his mind with some of the concepts in Einstein's Theory of Relativity. There is no absolute motion or time; light always moves through space at the same speed, length shortens with speed, and mass increases with velocity.		X	Good	Good	Average
Freeman, Mae and Ira 1959 THE SUN, THE MOON AND THE STARS ** Random House $1.95 Covers basic material in simple language young children can understand.		X	Good	Good	Easy

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 19

IV. The Universe - D. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Gallant, Roy A. 1958 EXPLORING THE PLANETS ** Doubleday $2.95 Facts about each planet; its formation, diameter, surface features, moons, rotation period, and orbit.	X	X	Good	Good	Difficult
Lauber, Patricia 1959 THE QUEST OF GALLILEO * Doubleday $3.00 This book tells the story of Gallileo in clear and vivid terms. It is very well illustrated in color.	X				
Johnson, Gaylord 1960 THE STORY OF PLANETS, SPACE AND STARS ** Harvey House $2.95 Astronomy for young readers.		X	Good	Good	Easy

* Good
** Excellent

IV. The Universe - D. (continued)	Tchr. Ref.	Illus	Learning Activities	Pupil Interest	Reading Level
Kiefer, Mildred S. 1965 PLANET X ** Melmont Publishers $2.00 This is an exciting story with pictures valuable in elementary science for its information on how astronomers work; the value of accurate scientific knowledge and analysis in the conquest of space; and the basic facts about the planets.		X		Good	Easy
Lauber, Patricia 1960 ALL ABOUT THE PLANETS * Random $1.95 Earth is a very special planet because it supports human life, and Earth is our observation station from which we look at the other eight planets that share our journey around the sun. Where did our sun and its planets come from? Do other planets circle other suns elsewhere in the universe? If so, do those planets support life? This book tells what astronomers have learned--and hope to learn--in answer to these exciting questions.				Average	Average

* Good
** Excellent

IV. The Universe - D. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Pickering, James S. 1961 CAPTIVES OF THE SUN ** Dodd $4.95 About moon, planets, comets, asteroids and meteors within the "captive" solar system.	X				
Reed, W. Maxwell, Brandwein, Paul F. 1960 THE STARS FOR SAM ** Harcourt $4.50 Describes our solar system, the universe and its galaxies, for young people. An up-to-date revision of one of the most outstanding children's books on astronomy.		X	Good	Good	Average
Schneider, Leo 1961 SPACE IN YOUR FUTURE ** Harcourt $3.75 Introduces boys and girls to the solar system, to galaxies and the tools of the astronomer. Includes list of planetariums and of astronomical organizations in the United States.		X	Good	Good	Average to Difficult

* Good
** Excellent

IV. The Universe

E. Stars and Galaxies	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Branley, Franklyn M. 1959 EXPERIMENTS IN SKY WATCHING ** Crowell. $3.50 The young sky watcher is given an introduction to orderly observation of the heavens and to experiments that will be of great interest.	X	X	Good	Good	Average
Crosby, Phoebe. 1960 JR. SCIENCE BOOK OF STARS ** Garrard. $2.50 For poor readers.		X	Average	Average	Easy
Fenton, Carroll Lane, and Mildred Adams Fenton. 1950 WORLDS IN THE SKY ** Day. $3.29 Presents basic astronomical facts. The illustrations are particularly clear and instructive. For slow readers.		X		Average	Easy
Grey, Vivian. 1960 THE FIRST BOOK OF ASTRONOMY * Watts. $2.50 For young readers.	X			Average	Average

* Good
** Excellent

IV. The Universe - E. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Moore, Patrick. 1957 THE AMATEUR ASTRONOMER * W. W. Norton & Co., Inc. $5.95 "This book is aimed at the needs of the beginner who is anxious to make a start with whatever equipment he can collect at limited cost."	X		Average		
Posin, Daniel Q. 1961 WHAT IS A STAR ** Benefic. $1.80 A factual account of the life cycle of a star, the structure of a star, the source of energy of a star, magnitudes and star color. Methods of studying the stars include distance measures and composition.		X		Good	Easy

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 21

IV. The Universe

E. Stars and Galaxies

E. Stars and Galaxies	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Freeman, Mae, and Ira Freeman 1953 FUN WITH ASTRONOMY ** Random $2.07 Simple experiments and excellent illustrations introduce the reader to the planets, the Milky Way, and the expanding universe.		X		Good	Average
Hoss, Norman, Blackwood, Paul E. 1960 THE HOW AND WHY BOOK OF STARS ** Grosset $1.00 Answers children's questions about the universe.		X	Average	Good	Average
Maloney, Terry 1961 THE STORY OF THE STARS * Sterling $2.50 Astronomer tells boys and girls in simple language some facts about stars.	X	X	Good		

* Good
** Excellent

SCIENCE RESOURCE BOOK BIBLIOGRAPHY - Grade 5
(Addendum)

Addition to
Page 21

IV. The Universe - E. (continued)	Tchr. Ref.	Illus.	Learning Activities	Pupil Interest	Reading Level
Rey, H. A. 1962 THE STARS: A NEW WAY TO SEE THEM ** Houghton $6.00 Guide to the constellations for beginners. Jacket unfolds into 22 x 26 inch map.	X			Good	Difficult
Rey, H. A. 1954 FIND THE CONSTELLATIONS ** Houghton $3.57 A delightful guide to star recognition.		X	Good	Good	Average

* Good
** Excellent

Grade Five

BASIC SCIENCE EDUCATION SERIES
Published by Row, Peterson & Co.

(Grade Placed for Major Topic in the Reorganized Science Curriculum)

Introduction to Science	Reading Level
A. Attitudes (including history)	
The Scientist and His Tools	4.5
Superstition or Science	5.8
B. Tools	
The Scientist and His Tools	4.5
Superstition or Science	5.8
C. Methods	
The Scientist and His Tools	4.5
Superstition or Science	5.8
I. The Earth	
G. Weather and climate	
Ask the Weatherman	5.9
Clouds, Rain and Snow	3.5
Ways of the Weather	4.9
II. Living Things	
A. Life and life processes	
Adaptation to Environment	5.1
Animals and Their Young	2.1
Animals That Live Together	1.9
Birds	3.8
Fishes	3.8
Flowers, Fruits, Seeds	3.8
How Animals Get Food	3.0
Insects and Their Ways	4.8
Seeds and Seed Travels	3.3

Grade Five

Basic Science Education Series (Continued)

II. Living Things

	Reading Level
A. Life and life processes	
Spiders	3.4
Toads and Frogs	3.2
Trees	4.5
You As A Machine	5.4
Watch Them Grow Up	2.0
B. Classification	
Animals of the Seashore	3.8
Animals We Know	4.2
Birds	3.8
Birds in Your Back Yard	-
Dependent Plants	3.7
Fishes	3.8
Flowers, Fruits, Seeds	3.8
The Insect Parade	3.1
Insects and Their Ways	4.8
Leaves	-
Living Things	2.9
Pebbles and Sea Shells	3.0
Reptiles	3.9
Six Legged Neighbors	-
Trees	4.5
C. Ecology	
Insect Friends and Enemies	5.6
D. Plant and animal economics	
Insect Friends and Enemies	5.6

Basic Science Education Series (continued)

	Reading Level
II. Living Things	
E. Human Body	
You as a Machine	5.4
III. Energy	
B. Sources and conservation of energy	
Doing Work	3.4
Fire	4.1
Fire, Friend and Foe	5.7
G. Electrical energy	
Electricity	4.1
I. Heat and infrared radiation	
Heat	5.1
Thermometers, Heat and Cold	3.8
IV. The Universe	
A. Earth	
How the Sun Helps Us	2.4
The Sun and Its Family	4.2
B. Moon	
The Earth's Nearest Neighbor	4.1
The Sky Above Us	3.5
C. Sun	
How The Sun Helps Us	2.4
The Sky Above Us	3.5
The Sun and Its Family	4.2
D. Solar System	
The Sky Above Us	3.5
The Sun and Its Family	4.2
E. Stars and galaxies	
Beyond the Solar System	5.4
The Sky Above Us	3.5

BIBLIO. - FILMS

For discussion purposes only

A PARTIAL LISTING OF PRESENTLY OWNED

SCIENCE MOTION PICTURE FILMS

GRADE FIVE

Correlated to the Unit Titles as found in the
Reorganized Science Curriculum

Minneapolis Public Schools
Science Department
1-20-65

For discussion purposes only

TABLE OF CONTENTS

Major Topic	Page Nuber	Color
Introduction to Science	1	Gray
I. The Earth		
G. Weather and climate	3	Pink
III. Energy		
B. Sources and conservation of energy	9	Yellow
I. Heat and infrared radiation	14	Yellow
O. Electrical energy	16	Yellow
IV. The Universe		
A. Earth	21	Blue
B. Moon	24	Blue
C. Sun	25	Blue
D. Solar system	26	Blue
E. Stars and galaxies	29	Blue
II. Living Things		
A. Life and life processes	31	Green
B. Classification	51	Green
E. Human body	60	Green

The annotations for films found on the following paes were obtained in most cases from the Library of Congress cards. Some annotations were secured from other sources suh as the Educational Film Guide and producers' catalogs.

Introduction to Science

Name and Description of Film	Other Grade Placements	Remarks
1. Dental Health: How and Why * Coronet, 1949; 11 min., black & white Reviews what research and experimentation have done to promote better dental health. Demonstrates new sodium fluoride applications and techniques of oral hygiene to show the relation of diet to the development and decay of teeth.		Also listed II-D
2. Science and Superstition ** Coronet, 1947; 11 min. Illustrates the use of the scientific method of working out everyday problems and reaching conclusions based on research and experimental evidence. Shows how science disproves superstitions about the groundhog, rabbit's foot, etc.	Gr. 7 - **	
3. What is Science? ** Coronet, 1947, 11 min. Explains that science is knowledge of the world about us. Two children, curious about common phenomena, conduct simple experiments and find their answers by using the scientific method; by observing, experimenting, drawing conclusions, and testing the results.	Gr. 7 - **	

* Good
** Excellent

I. The Earth

G. Weather and climate

Name and Description of Film	Other Grade Placements	Remarks
1. Air and What it Does EBF, 1962; 11 min., color The problem-solving approach to a series of real-life situations gives children an opportunity to "discover" basic concepts about air for themselves. Through demonstrations--a blow-out, turning windmill, helicopter, sailboat, beach ball, floating bottle, campfire, an accordian, an experiment with a balloon fastened to an empty can which is heated, then cooled--children learn that though air cannot be seen, its many effects make known its properties and what it does: it takes up space, expands, contracts, has weight and force.		No eval. yet
2. Climate and the World We Live In ** Coronet, 1957; 14 min. Shows the determining factors of climate: latitude, altidude, nearness to water, ocean currents, prevailing winds, and mountain ranges. Explains the grouping of similar climates into major types, and represents regions of the world to show how variations in climate affect human activities.	Gr. 8 - **	
3. Eyes in Outer Space ** Walt Disney, 1959; 26 min., color Describes the work of weather stations today in forecasting weather and possible use in the future of satellites and rockets to control weather and avert destructive storms and hurricanes.	Gr. 8 - **	

* Good
** Excellent

The Earth - O. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. How Weather is Forecast ** Coronet, 1953; 11 min. Shows the operation of a weather observation station and a weather forecasting station; describes the instruments used in weather forecasting and their functions; explains the importance of forecasting to various occupational groups and to the inhabitants of flood areas. Animated sequences are used to show the charting of a weather map and to explain the symbols used.	Gr. 3 - * Gr. 8 - **	Difficult
5. One Rainy Day: Background for Reading and Expression * Coronet, 1953; 10 min. On a rainy day, a primary grade class listens to a story about the way a storm begins and what rain does for soil, plants, and people.		Simple
6. Our Weather * EBF, 1955; 11 min., black & white Animation and microphotography are used in explaining why weather changes, how meteorologists predict changes, and how weather affects everyday activities. Discusses the air mass theory and the formation of dew, frost, and snow. Includes visits to a weather observation station where the purpose of various instruments is explained, and to a forecasting office where weather maps are plotted from data received from observation stations.	Gr. 8 - **	

* Good
** Excellent

The Earth - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
7. The Seasons * Teaching Film Custodians, 1948; 22 min., color Explains why the seasons change throughout the year. Through animated drawings shows the tilt of the earth's axis, the rotation of the earth upon its axis, the revolution of the earth around the sun, and the effect of these movements upon the sun's rays.		
8. A Story of a Storm ** Coronet, 1950; 11 min. Shows the various conditions which cause a rainstorm to develop. Covers the names of clouds, knowledge of pressure areas, fronts, and meteorological information. Traces the results of a single storm.	Gr. 8 - **	
9. Unchained Goddess * N. W. Bell Telephone, 1960; 60 min., color This Bell System science picture deals with the story, in its many facets, of what scientists today know about what makes the weather. Dr. Frank Baxter and Richard Carlson are again the stars in this Frank Capra production. Animation, cartoon characters, stills from scientific pictures and live photography are used. The Weather Goddess "Meteora" is featured in this film.	Gr. 8 - **	

* Good
** Excellent

The Earth - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
10. Up in the Air: Exploring our Atmosphere ** Grover Jennings, 1961; 12 min., color Air movements; what is in the air; what fog and clouds are; how they form; what happens to them; how cloud changes show air movements; how air movements shape clouds; what air looks like from miles above the earth..all shown in actual live-action photography; developing simply and easily basic concepts essential to understanding air and weather.	Gr. 8 - **	
11. Water in the Weather ** Academy, 1960; 17 min., color What makes the weather? Heat from the sun, the earth's atmosphere, land areas and water areas all work together as weather makers. The earth's atmosphere is a protective layer which filters out harmful rays from the sun. The clouds drop their moisture as rain, hail or snow. This is the endless cycle of "Water in the Weather".	Gr. 8 - **	Needs prep.
12. What Makes Rain * Young America, 1947; 10 min., black & white Explains, through a letter which the weather man writes to a young boy, evaporation and condensation as they apply to the water cycle. Includes animated drawings.	Gr. 4 - **	

* Good
** Excellent

The Earth - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
13. Why Seasons Change * EBF, 1960; 11 min., black & white Shows why seasons change, making use of animated drawings to show why the tilt of the earth gives us short days in winter and long ones in summer. Also explains why it is hot in summer and cold in winter. Follows also the orbit of the earth through a complete year.	Gr. 5 - Gr. 8 - **	Also listed IV-A
14. Winds and Their Causes ** Coronet, 1948; 11 min. When his gasoline-powered model airplane crashes over a bare field, a young boy becomes interested in winds and obtains information from personal observation, from books, and from an aviator. Explains thermals, cumulus clouds, thunderstorms, the great winds of the earth, on- and off-shore breezes, and the easterlies and westerlies.	Gr. 8 - **	

* Good
** Excellent

III. Energy

B. Sources and conservation of energy

Name and Description of Film	Other Grade Placements	Remarks
1. Electrons at Work ** EBF, 1961; 14 min., color Presents examples of electrons at work, showing how they supply energy to turn a paddle wheel, to create a picture on a television screen, and to operate an electronic computor. Uses simple experiments and demonstrations to illustrate the characteristics of electrons, and to show how they can be controlled for useful purposes.	Gr. 9 - **	
2. Energy ** McGraw-Hill, 1956; 13 min., black & white Defines energy, potential energy, and kinetic energy; explains why inert substances have energy, how energy from the sun is changed to energy which can be used, and how energy is changed from one form to another; explains the law of conservation of energy; and describes forms of energy, including mechanical, electrical, heat, and chemical.		
3. Energy and Power: A First Look ** Journal Films, 1962; 10 min., color Through an artwork sequence taking us back to the days of the caveman, the film shows us man's first attempt to use energy. The sequence indicates the discovery of the simple machines and shows his first realization of the energy stored within wood, running water and wind. The film goes on to survey how we now use the energy of wind and water--and many other kinds of energy such as electricity, fuel and dynamite. Through a series of comparisons showihg man lifting, pushing and digging, we see that the machines which he has built have made his work easier.		

* Good
** Excellent

Energy - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. Energy in our Rivers ** Coronet, 1948; 11 min. Dramatizes the story of how rivers through the centuries have furnished the energy and power necessary to man's existence. Extends from the days of the ancient water-wheel to the era of dams and hydro-electric plants which furnish electricity to cities and factories and irrigate miles of farmland.		
5. Fire Science ** Churchill-Wexler, 1960; 15 min., color An introduction to the chemistry of combustion. Highlights historical uses of fire and the importance of fire in today's civilization. Uses animation to visualize the molecular action of a burning fuel whose carbon and hydrogen atoms combine with oxygen to form carbon dioxide and water, releasing energy in the form of heat and light. Experiments explain the concepts of fuel, oxidation, kindling temperature, and spontaneous combustion.	Gr. 6 - ** Gr. 9 - *	
6. Fuels--Their Nature and Use ** EBF, 1958; 11 min. Describes the principal kinds of fuels used in homes and industry; traces the source of most conventional fuels to the sun; and explains the history of fuels. Uses animation to explain how heat is transferred to mechanical energy in steam, gasoline, and diesel engines.	Gr. 7 - ** Gr. 9 - ** Gr. 11 - *	

* Good
** Excellent

Electrons At Work

Film Summary

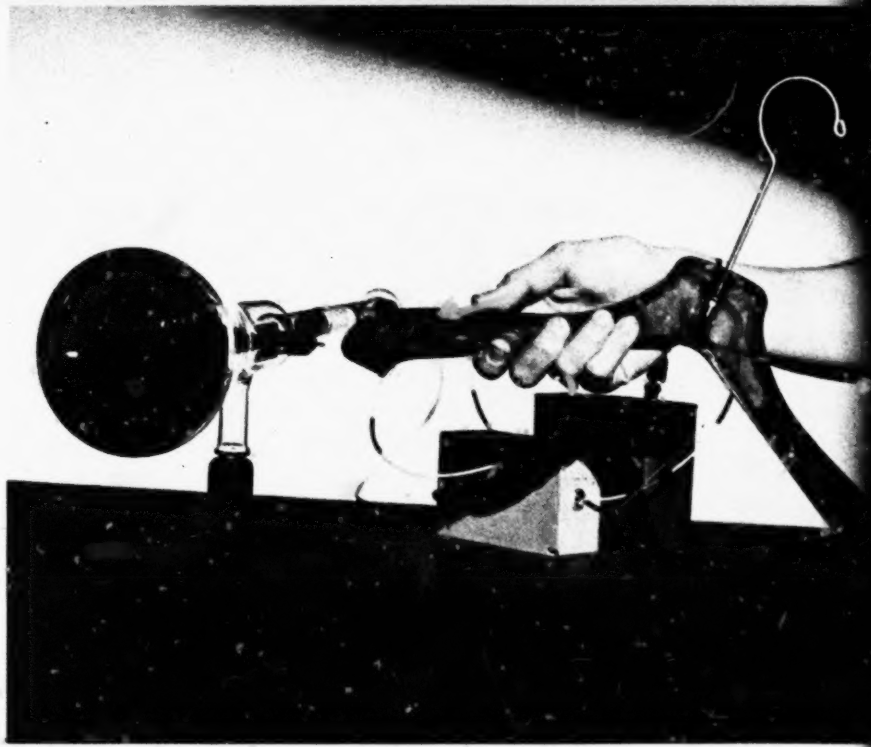
We see a simple circuit—a light bulb, a battery, and a meter. When the circuit is complete, electric charges flow. When the wires to the battery are reversed, the meter shows that the charges flow in the opposite direction. Add another light bulb to the circuit, and more electric charges flow. The basic electric charge is a particle called the electron. But we cannot see electrons. So how do we know they exist?

We see the power of a hurricane wind, bending trees, blowing a sign down, whipping debris down the street. We cannot see the wind, but we believe that there is such a thing as a wind because we can see things the wind does.

We look closely at a small paddle wheel turning. Is the wind hitting against it and making the wheel turn? No, because the paddle wheel is enclosed in a glass tube. Electrons are hitting against the blades of the wheel, making it turn. When the power supply is disconnected, the wheel stops turning. When the circuit is complete, electrons flow through the tube and hit against the blades of the wheel. When the wires are reversed so that the electrons flow in the opposite direction, they hit the other sides of the blades of the wheel and the wheel turns in the other direction.

A wrecking ball smashes against the side of a building. An object has to have mass to move other objects by colliding with them. If the wrecking ball did not have mass, it would not knock holes in the side of the building. We look again at the paddle wheel inside the glass tube. If the electrons did not have mass, they could not hit against the wheel and make it turn.

We look closely at a blue liquid being poured into a glass container. Every material is made up of tiny particles called atoms. This liquid is called copper sulphate. It is partly made up of atoms of copper. Two strips of platinum are dipped into the copper sulphate. A circuit is completed so that electrons flow through the two strips. When the strips are removed, one has a thin coating of copper. The strips are returned to the copper sulphate and the wires to the battery are reversed. When the platinum strips are removed again, the one that had the copper coat is clean. The copper is now on the other strip. It is as if electrons were connected to copper atoms—because when electrons flow in this circuit, copper atoms move, too.



We look closely at two helium-filled balloons. Balloons are made of atoms. Electrons are connected to atoms, so there are electrons on the balloons. There are also electrons in a silk scarf. When the balloons are rubbed with the silk scarf, electrons are actually rubbed off the silk onto the balloons. The silk now has a shortage of electrons; the balloons have extra electrons. Objects with a shortage of electrons or objects with extra electrons are said to have an electric charge.

When objects have the same kind of charge, they repel each other. A plastic coat hanger is rubbed with a silk scarf. Electrons are being rubbed off the scarf onto the hanger. Since the hanger has extra electrons, and the balloons both have extra electrons, the hanger repels the balloons. Objects with different kinds of charges attract each other. The scarf has a shortage of electrons; it attracts the balloons.

Now we look at several common objects: a hairbrush, a cat, and a banana. Here is visual evidence that electrons can be found in all kinds of materials: a hairbrush rubbed on the cat, attracts a banana.

A stream of electrons is being sent down a long vacuum tube. When the electrons hit against a coating of fluorescent paint at one end of the tube, they make a spot of green light. The spot of light can be repelled by a plastic coat hanger that has been rubbed with silk. Apparently, the coat hanger and the stream of electrons have the same kind of charge. If the stream of electrons could be repelled and attracted fast enough, and in just the right directions, we could make a picture as complicated as a television picture.

We look closely at the picture on a television screen and see that it is made by a stream of electrons that hit against a screen painted with fluorescent paint. We can see the lines made by the stream of electrons as it is moved back and forth across the screen at a very high speed. Inside the TV set are several electron tubes. They control the electric charges that make the stream of electrons move in a proper way to form a picture. Electron tubes act like valves that can turn a flow of electrons on and off.

Now we look at a bank of transistors. Transistors can do what electron tubes do, although they do it in a different way. We move back from the transistors and see that they are part of the complex circuitry of a large electronic computer. Electrons themselves, moving in the circuits of the computer, are the important moving parts of the machine. Because they move quickly and are easy to control, the electronic computer can work very quickly. It takes the computer only a millionth of a second to add a long column of large numbers together.

Introduction to the Film

Electric current is the flow of electric charges. The smallest unit in which electric charge can be found in nature is called the electron. Atoms are so tiny that they cannot be clearly seen even under the most powerful microscopes. Yet electrons, which are associated with atoms, are much tinier still. No one has seen a single atom, and of course no one has seen an electron. But we believe electrons exist because we can see things that they do.

For example, fast-moving electrons can cause a fluorescent screen to light up. This is exactly what happens on the screen of your television tube. The screen is literally bathed by a stream of electrons landing in just the right places to produce a picture. So, although you can't see electrons themselves, you can, in some cases, see where they land because they produce a momentary flash of light. This is a very useful way of "looking" at electrons. Of course, long before television was invented, there were indirect proofs of the existence of electrons. In fact, if these bits of evidence that something called electrons did exist had not been available, television and the host of electronic machines and instruments so important to our life today could never have been invented at all.

A copper wire leading from a battery to an electric light bulb has electrons in it. When the wire is part of a complete circuit and there is a current, these electrons move. Electrons can flow freely through the metal wire. In other materials such as glass or plastic, which are called non-conductors, electrons do not flow very readily. But there are electrons in these materials nevertheless. All materials are made up of atoms, and all atoms have electrons associated with them. Wherever there are atoms, there are electrons. The difference between a non-conducting material and a conducting material is that the electrons move more easily in one than in the other.

You can rub two solid materials together and actually remove electrons from the surface of one of the materials, and deposit them on the other. Because of this, rubbing two objects together can often cause electrical effects. What happens when you rub a plastic coat hanger with a silk scarf? The plastic is made up of certain combinations of certain kinds of atoms. Each different kind of atom has a particular number of electrons associated with it. So the plastic coat hanger hanging in a closet has just as many electrons in it as should be associated with the kind and number of atoms of which the coat hanger is made. In other words, it has a *normal* number of electrons. The same is true of the silk scarf lying folded in a nearby drawer. Now, bring the plastic coat hanger and the silk scarf together and rub them together. What happens? The rubbing action actually rubs electrons off one onto the other. Which way the electrons go depends on the particular atomic make-up of the two materials involved. Let's say for the sake of the illustration that electrons are rubbed off the silk onto the coat hanger. Stop rubbing. Now neither the coat hanger nor the scarf has its normal quota of electrons. The coat hanger has too many, and the scarf has too few. *Any object that has extra electrons, or any object that has a shortage of electrons, is said to have an electric charge.* There are two kinds of charge: a too-many-electrons charge, and a too-few-electrons charge. Experiments shown in the film (and these are experiments you can duplicate yourself) indicate that objects with the same kind of charge repel each other, while objects with different kinds of charges attract each other.

The two kinds of charges are not named in the film, but the names are common. An object with a shortage of electrons is said to have a *positive* charge. An object with extra electrons is said to have a *negative* charge. The apparent reversal of terms (i.e., *negative* for something with *extra* electrons) is brought about because electrons themselves are all said to have negative charges. The more electrons there are collected on an object, the more negative its charge will be.

Since electrons all have the same kind of charge, electrons will repel one another. The fact that electrons do repel each other is very useful when you are concerned with controlling the flow of electrons. You can control the movement of a stream of electrons by repelling them with a supply of stationary electrons collected on a metal plate, for example. This is what happens inside electron tubes.

There are electrons in all materials, but electrons can move where there are no materials present at all — that is, in a vacuum. The electron tubes in radios and television sets are vacuum tubes. They are called vacuum tubes because practically all the air and other gases have been removed from them. Why? Well, actually to allow electrons to move about inside them as freely as possible. A vacuum provides a minimum of obstacles to the movement of electrons.

The mass of a single electron is billions and billions of times smaller than that of the tiniest grain of sand you can imagine. Because electrons are so light, they are easy to set in motion. If they move in a vacuum, there are few obstacles to interfere with their movement. And their movement can be easily controlled by other electrons. Because electrons can be so conveniently controlled, they have become very useful servants. The basic moving part in any electronic device is the electron itself moving in a controlled way through the circuits of the machine.

NOTE: In the film, electrons are shown causing a wheel to rotate, and we say that the effect is due to the mass of the electrons. The electrons hit the wheel and make it turn. It should be pointed out here that while it is true that electrons have mass and momentum, the spinning of the wheel actually is due to a more complicated phenomenon involving some of the gas that is left inside the tube. The wheel rotates under the action of molecules that have been given extra energy due to the presence of the moving electrons.

Demonstration To Be Presented Before Showing The Film

Blow up two balloons of equal size. Tie them with strings and hang both of them by their strings from a common support. The balloons will hang down, touching each other. Now, rub both balloons with a silk cloth. The balloons should repel each other. Rub a plastic coat hanger or comb with a silk cloth. Bring the comb between the balloons; the balloons should be repelled more. Bring the silk cloth between the balloons; the cloth should attract the balloons. Remind the class that there are three basic groups of forces: electrical forces, gravitational forces, and nuclear forces. Ask the class into which group the forces fall that are making the balloons move.

NOTE: Electrostatic experiments are unpredictable. The amount of moisture in the air has a great effect on their outcome. The drier the air, the better. It would be wise to try this experiment ahead of time before the class is in the room, but as soon before actual class time as possible. Sometimes, heating the objects involved in front of an electric light bulb will help. In any case, do not expect perfect results. Even partially successful results from this experiment should still be of great value if presented in front of your class prior to screening the film.

Experiments and Projects

1. Instructions for building a gold-leaf electroscope will be found in the notes for WHAT IS ELECTRIC CURRENT? on page 57. A copper wire strung between two milk bottles, a distance of 5 to 10 feet apart, can be connected to the electroscope top with a piece of tape. If a charged plastic coat hanger (charge it by rubbing with silk) is brought near the distant end of the wire, it will cause the leaves of the electroscope to fly apart. The explanation is that excess electrons on the coat hanger push electrons along the wire and dump them onto the leaves of the electroscope. The

leaves now have like charges and repel each other. That is, both leaves of the electroscope have extra electrons, so they repel each other.

2. Several experiments should be made to confirm the laws of attraction and repulsion. That is, that objects with like charges repel, and objects with different charges attract. Suppose B repels A, and suppose C repels A. Will B repel C? (Yes.) Similarly, suppose B attracts A, and suppose C attracts A. Will B attract C? (No.) Try it and find out, using balloons, plastic objects, and silk and wool cloths.

3. Hang a banana so that it is free to rotate in a horizontal plane. (See FIGURE ONE, page 23.) Wait until the hanging banana comes to rest. Now, see how many different objects can be given a charge and used to attract the banana. A comb that has been rubbed through your hair several times may do it—or a piece of plastic rubbed with a wool or silk cloth. A bottle that has been rubbed with one of the cloths—or even an old shoe—may work. Try a wide variety of objects. Do any of them repel the banana? Hang another object in the same manner in which the banana was hung—a bottle, perhaps, or a metal fork. See what charged objects will attract and repel the new hanging object. Give a hanging object (choose a non-conductor) a charge by rubbing it with a wool cloth. What effect do other charged objects have on the hanging object now?

Correlated References for Students and Teachers

TEXT REFERENCES FOR STUDENTS

Barnard, Stendler, Spock and Beeler
Science: A Way to Solve Problems, Grade 8
The Macmillan Co., 1960
Unit 3, pp. 116-131

Beauchamp, Mayfield and West
Science Problems—1, Grade 7
Scott, Foresman and Co., 1957
Unit 1, p. 27

Beauchamp, Mayfield and West
Science Problems—2, Grade 8
Scott, Foresman and Co., 1957
Unit 7, pp. 258-266

Beauchamp, Mayfield and West
Science Problems—3, Grade 9
Scott, Foresman and Co., 1957
Units 2 and 3, pp. 93-152

Beauchamp, Mayfield and West
Everyday Problems in Science, Grade 9
Scott, Foresman and Co., 1957
Unit 16, pp. 374-375, 388, 394

Craig, Roche and Navarra
Science Today and Tomorrow Series, Book VI
Ginn and Co., 1958
pp. 4-27

Craig and Urban
Facing Tomorrow with Science, Book VIII
Ginn and Co., 1958
pp. 4-27

Frasier, MacCracken and Decker
Singer Science Series, Book VI
L. W. Singer Co., Inc., 1959
pp. 270-289

Frasier, MacCracken and Decker
Our Scientific World, Book VIII
L. W. Singer Co., Inc., 1956
Unit 1, pp. 34-41

Jacobson and Lauby
ABC Science Series, Book VI
American Book Co., 1961
pp. 271-326

Schneider, Herman and Nina
Heath Elementary Science Series, Book V
D. C. Heath and Co., 1955
pp. 269-282

SUPPLEMENTARY READING FOR STUDENTS

Fink and Lutjens
The Physics of Television
Doubleday Anchor Books, 1960
Wesleyan University Press

Llewellen, John R.
Understanding Electronics
Thomas Y. Crowell Co., 1957

Pierce, John R.
Electrons, Waves and Messages
Doubleday and Co., Inc., 1956

Yates, R. F.
Fun with Electrons
Appleton-Century-Crofts, Inc., 1945

REFERENCES FOR TEACHERS

Blackwood, Herron and Kelly
High School Physics
Ginn and Co., 1958
Chapter 24, pp. 400-423
Chapter 25, pp. 424-431

Brinckerhoff, Cross, Watson and Brandwein
The Physical World
Harcourt, Brace and Co., 1958
Chapter 23, pp. 258-267

Dull, Metcalfe and Williams
Modern Physics
Henry Holt and Co., 1960
Unit 3, chapter 6, pp. 137-151

Mallinson, Mallinson and Welch
General Physical Science
McGraw-Hill Book Co., Inc., 1961
Unit 10, chapter 31, pp. 493-510

Marburger and Hoffman
Physics for Our Times
McGraw-Hill Book Co., Inc., 1955
Unit 4, chapter 14, pp. 334-358

Physical Science Study Committee
Physics
D. C. Heath and Co., 1960
Chapters 32-33, pp. 572-614

White, Harvey E.
Physics: An Exact Science
D. Van Nostrand Co., Inc., 1959
pp. 443-452, 494-498, 514-518

Energy - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
7. Hoover Dam ** U.S. Off. of Educa., 1950; 33 min., b&w Reviews the building of Hoover Dam and explains its values in furnishing irrigation water and electric power to the people in the southwestern United States.	Gr. 9- **	
8. Mighty Columbia River * Coronet, 1948; 11 min. Put to work by Grand Coulee and Bonneville Dams, the Columbia River is one of the world's greatest sources of hydroelectric power; a busy pathway of shipping traffic; a rich fishing bed for the salmon industry; and a source of irrigation for the broad farmlands of the Northwest.		
9. The Strange Case of the Cosmic Rays ** N.W. Bell Tele., 1960; 60 min., color Tells the story of how scientists around the world track cosmic rays and establish their mysterious character and behavior. Frank Capra, producer, uses actors, animation and cartoon characters, science motion pictures and puppets. Stars in this picture are Dr. Frank Baxter and Richard Carlson.	Gr. 9 - ** Gr. 11 - **	

* Good
** Excellent

Energy - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
10. The Sun's Energy ** Academy, 1960; 16½ min., color This film explains why the sun's energy is the basis of all life on earth and the source of all types of industrial energy except atomic energy. Green leaves of plants use the sun's energy to manufacture food, which is stored in fruits, seeds, stems and roots. Human beings get much of their energy by eating the seeds, fruits and roots of many different plants. So directly or indirectly, plants sustain all animal life and green plants depend on sunlight.	Gr. 9 - ** Gr. 8 - **	
11. Understanding Fire * Coronet, 1956; 10 min. A young boy, helping his father to build a fire in an outdoor fireplace, becomes interested in the characteristics of fire and its uses. He learns that the basic requirements of fire are fuel, heat, and oxygen, and realizes that the usefulness of fire depends upon its control.	Gr. 3 - **	Easy film
	Gr. 4 - **	
	Gr. 7 - **	For slow 7th
12. Understanding Matter and Energy * Int'l Film Bureau, 1962; 18 min., color In a fascinating film technique, the "conversation" a boy has with a narrator leads to a thorough demonstration of the physical properties of matter in its solid, liquid or gaseous state. Animation clarifies the molecular action of matter while it is a solid, liquid or gas. The concept that matter may be transformed into energy and that these sources of energy, heat, chemical, mechanical, light, electrical, are utilized to serve man is also shown.	Gr. 6 - ** Gr. 9 - **	

* Good
** Excellent

Energy - B. (continued)

Name and Descritption of Film	Other Grade Placements	Remarks
13. Water Power ** EBF, 1937; 11 min., black & white Presents the concept of water as a power source, and demonstrates how man has learned to harness this power. Traces development of water power from small colonial mills to giant modern hydroelectric plants. Through animated drawings, illustrates the transformation of potential energy into kinetic energy as water surges through a turbine. Concludes with a world-wide survey of potential water power.	Gr. 7 - ** Gr. 9 - *	
14. Waves and Energy ** EBF, 1961; 11 min., color Explains that there are many kinds of waves, including water, sound, light, and radio waves. Uses illustrations and experiments to show how waves carry energy from one place to another. Describes the relationship between frequence and wave length; and explains how radio waves carry information.	Gr. 9 - **	
15. We Use Power ** Churchill-Wexler, 1957; 11 min. Joan and Jimmie observe a series of experiments showing the use of the power in wind, water, steam electricity, and internal combustion engines. Small, simplified models are used.	Gr. 9 - *	

* Good
** Excellent

III. Energy

I. Heat and infrared radiation

Name and Description of Film	Other Grade Placements	Remarks
1. Heat and How We Use It EBF, 1963; 11 min., color Two boys experiment with heat discovering its nature, its characteristics, how it travels, and its uses in everyday life. When they stir cocoa with a wooden spoon the spoon handle does not get hot; when they use a metal spoon it burns their hands, but the thick cloth of a potholder slows the heat, acting as an insulator. An experiment shows that heat travels quickly through metals and slowly through wood and glass, and that though most things expand when they are heated, some expand more quickly than others. Heat always moves away from the place where it started. Without the sun--the source of heat--there would be no life on earth.		No eval. yet
2. Heat--Its Nature and Transfer ** EBF, 1958; 11 min., black & white Combines live photography with animated drawings to explain the nature of heat and some of the principal ways in which heat is transferred. Deals with such characteristics of heat as conduction, convection, and radiation; develops the concept of insulation; and illustrates and discusses practical applications of heat in home and industry.	Gr. 9 - * Gr. 11 - *	For review

* Good
** Excellent

Waves and Energy

Film Summary

A large boat passes by. Some of the energy that does the work of making the boat go forward is used to move water and, incidentally, to make waves. Some distance away a small rowboat is anchored. Two men sit in it, fishing. When the waves reach the rowboat several moments later, they make it pitch up and down. It takes energy to make something move. Apparently, waves can carry energy from one place to another—in this case, from the large boat to the rowboat.

In a bowling alley, we see that there is another way to move energy from one place to another. You bowl a ball, and some of the energy it takes to roll the ball down the alley is carried by the moving ball to the other end of the alley, where it does the work of knocking the pins down. It's not a strike. One pin is left standing. This one will be knocked down with a wave. How? A stretched spring is run the length of the alley. The girl who has been bowling hits the stretched spring once. A wave travels along the spring down to the other end of the alley, hits against the remaining pin and knocks it over. The bowling ball carries energy from one place to another by moving between the two places. But with the wave in the stretched spring, no object moves from one end of the alley to the other, only energy.

Several toy boats are anchored at one end of an aquarium. Some dye is squirted into the water at the middle of the aquarium. Then waves are made by agitating the water at the far end. The waves travel the length of the aquarium and make the boats rock. Energy is moving from one end of the aquarium to the other. But the dye in the middle stays pretty much in the same place, indicating that only energy is moving, not water.

A glass is set in front of a powerful loudspeaker. When the sound volume is turned up, the glass cracks. Energy has been carried from one place to another, from the speaker to the glass. But no object has been moved between the two places. Is it possible that sound energy also travels in waves?

We see waves traveling from the large boat to the rowboat, and we see that it takes time for them to move from one place to another. Now, there is lightning on the horizon. But it is several moments before we hear the thunder. It takes sound time to move from one place to another. This is another indication that sound may be traveling in waves.

In a laboratory we observe waves in a stretched spring. We see trains of waves, and discover that a wave length is the distance between two adjacent similar parts of the train of waves. The faster the waves are generated—that is, the more there are per second, the shorter the wave length is. Using a stretched spring, we see that waves can be reflected. A single wave travels to the end of the spring and bounces back.

A ship is traveling through a heavy fog. Sound waves from a foghorn tell the captain that there is another ship somewhere out there in the fog. In other words, these sound waves are carrying information. The captain has other methods of getting information. We see the radarscope. Radio signals are sent out from the turning antenna. When they hit something out there in the fog, they bounce back, and an indication of the object is formed on the scope.

We see a transmitter that can send a signal to the moon. We watch an oscilloscope and listen to the sound as the signal hits the moon and is bounced back, returning to the earth some seconds later. The radio signal has been reflected and has taken time to travel from one place to another. Is it possible that radio signals also travel in waves?

In a close-up view of the sun, we see the solar prominences leaping out from the sun's surface. If the sun is the source of energy for the entire solar system, how does that energy travel from the sun to the planets? Do objects move between the sun and the earth, carrying energy? Or is it possible that this energy travels in waves?

Introduction to the Film

Why do we study waves? There are two important reasons. One is that waves can carry energy from one place to another. The other is that waves can carry information from one place to another. Of course, these two things are not separate from one another. Waves can carry information because they carry energy.

It takes a great deal of energy to lift something that weighs a ton to a height of a hundred feet, but it takes only a small amount of energy to send the tinkle of a bell to a distance of fifty feet in all directions. Now you may not think it is possible for waves to carry enough energy to lift something that weighs a ton, but consider a giant redwood tree. How did it get up there? The energy needed to lift that tree into the air came, indirectly, from the sun, which is 93,000,000 miles away. And not only has the energy from the sun lifted every tree that has ever grown, it has also powered every waterfall, stockpiled every coal mine and generated every tornado that ever existed. And the energy from the sun travels to the earth in waves.

Light and sound are both examples of waves, but sound is invisible and light reveals the secrets of its wave-like character only under close scrutiny. If we tentatively accept the fact that both light and sound travel as waves, we have immediate confirmation of the idea that waves carry both information and energy. It doesn't take much energy to wind an alarm clock. When the alarm goes off, information in the form of sound is spread rapidly in all directions and can be picked up at a great distance.

The fact that only tiny amounts of energy are needed to convey information was dramatically illustrated by the satellite "Pioneer V." Its radio wave signals, coming from a fifty-watt transmitter, were still detectable on the earth when the satellite was 8,000,000 miles away. On the other hand, energy from the sun lands at the rate of about two and a half horsepower on a four-foot-square plot of earth. The power we receive from the distant sun is truly lavish.

How can you tell a wave when you see one? Perhaps the first thing you think of when someone mentions waves is breakers at the beach. We will begin our study of waves using waves on the surface of water because they are easy to see. Imagine lots of rowboats anchored in a line on a calm lake. The people in them are fishing and enjoying the quiet. A few hundred feet away a powerful speedboat goes by. Before long, the waves from the speedboat reach the first rowboat and cause it to bob up and down. The waves have carried energy from the speedboat to the rowboat. The other rowboats are not affected until a wave reaches them too.

Now, we'll go to the shore of a very still pond. A good way to generate ripples is to hold a burnt-out electric light bulb by the neck and partially immerse the round part in the water, and bob it up and down. The ripples you generate travel away from the bulb in concentric circles. This is an example of a wave. If you bob the bulb up and down at the rate of about 2 times per second, and do this in a fairly regular manner, you will see crests, separated by a constant distance, moving out away from the source at a certain speed. We call that the speed of the wave. If you bob the bulb up and down twice as fast, you will observe that the crests are closer to one another. But close observation will show that they are still traveling away from the light bulb at the same speed. The distance between the crests is called the *wave length* of the wave. The more waves that are generated per second; that is, the higher the frequency of the wave, the shorter the wave length. This is the kind of observation that we want to make about waves because what we learn here, looking at water waves, is applicable to sound waves, light waves, radio waves, and all other kinds of waves.

Despite the obvious differences between these different kinds of waves, there are certain characteristics common to waves of all kinds. For example, waves of all kinds take *time* to travel from one place to another. It takes time for a wave in water to travel from one place to another. It takes time for sound to travel from one place to another—something we can prove by watching distant lightning and observing that time passes before we hear the sound of the thunder. It also takes time for light to travel, about eight minutes for it to travel from the sun to the earth. Radio waves take time to travel. A radio signal sent to the moon hits the moon, bounces back, and is received on earth some seconds after it was sent. And this leads us to another common characteristic of all waves. They can be reflected. When they hit something, they bounce.

As a matter of fact, most of the evidence indicating that things such as light and sound travel in waves is based on observations that show that light and sound behave in certain ways characteristic of waves in general.

Demonstration To Be Presented Before Showing the Film

Stand a long row of dominoes on end on a table-top in front of the class. Position the dominoes in such a way that when the first one is knocked over, it will hit the second; the second, in falling, will hit the third; and so on all the way down the line until all of the dominoes have been knocked over. Place an additional domino on end in front of the rest so that it will not hit the others when it falls. Knock the single domino over. Ask the class if it took energy to knock that domino down.

Of course it did.

Now knock over the first domino in the row, and down go all the rest. Indicate the last domino in the row, the last one to go down, and ask if it took energy to knock that one down.

Certainly.

Where did that energy come from?

Discussion should bring out the idea that the energy must have come from the energy used to knock over the first domino in the row. But how did that energy travel from one end of the row of dominoes to the other? It traveled in a wave. And questions about waves should lead to the introduction of the film.

Experiments and Projects

1. Have half the class form a long file. Instruct the students in the file to hold their hands up over their heads. The student at the back of the file will be called the first man. Instruct him to bring his arms straight down when you tap him on the shoulder, so that his hands are placed on the shoulders of the student in front of him. Instruct all the other students in the file that as soon as they feel the hands of the student behind them, then they should bring down their arms so that their hands rest on the shoulders of the student in front. Tap the first man on the shoulder. You should observe a pulse traveling along the file of students. Now advise the first man to raise his arms again and instruct the other students in the file to raise their arms as soon as they feel the hands raised from their shoulders. Now you will see a pulse of a different kind traveling in the same direction along the line of students. Instruct the first man to raise and then lower his arms in a regular rhythm. You will see a wave-like motion progressing along the line of students. The important thing to observe here is that whatever one student does will eventually be done by another student at a later time. This is one of the important characteristics of a wave.

2. Get as many sets of dominoes as you possibly can. Stand them up like soldiers with the distances between them equal, but less than their height. Push the first domino. A watch with a second hand can be used to measure the length of time required for the pulse to travel from the first domino to the last. Do the experiment several times to see if the pulse travels with about the same speed each time.

3. Find two boxes that can float and put them on the surface of a still pond, fifty feet or more from one another. Start bobbing one of the boxes up and down vertically by applying a rhythmic pulse to it with your hand. Watch what happens to the other box. Would you say that energy is being transported from one box to the other?

4. A burnt-out light bulb can be used to make ripples. Hold the bulb by the spiral screw stem and submerge the round part of the bulb in the pond. Bob it up and down at the rate of one time per second. Measure, or estimate, the distance between crests and record it. Now vibrate the bulb up and down twice per second and measure the distance between crests again. Now bob the bulb up and down four times per second, and measure the distance between crests again. Does the wave length grow shorter as the frequency of the wave is increased?

5. The long spiral spring used in the film is a toy called a "Slinky." If one of these is available to the class, it can be used in a wide range of experiments related to waves. The Slinky should be stretched over a smooth hard surface—a composition floor, for example—to a length of about thirty feet. One student holds each end. By vibrating one end of the stretched spring in a regular rhythm, you can set up a train of waves. Does the wave length grow shorter as the frequency of the waves is increased?

6. There are several different ways to measure the speed of sound. One way is to have a student stand at an exposed point holding two garbage can covers like cymbals. This student must be a considerable distance from the rest of the class, at least two thousand feet. And the distance must be a known one—one, perhaps, which has

been measured on the mileage gauge of a car. The teacher, standing with the larger group of students, must have a watch with a second hand, or if one is available, a stop watch. When the distant student hits the "cymbals" together, the teacher and students two thousand feet away need only measure the time that goes by after they see the "cymbals" hit until they hear the sound. That is the length of time it took sound to travel that far.

7. If you clap your hands once loudly in a closed room, you are likely to get a good indication that sound can be reflected. An echo is reflected sound. Try clapping your hands in different rooms and in different places outdoors. When you succeed in getting an echo, can you discover what the sound is being reflected by? What does it hit against to be bounced back?

8. If you take the streams of water from two hoses and try to make them cross, you will see that one stream affects the other. But if you take the beams of light from two flashlights, you can make one beam cross the other without affecting it. If you do this experiment, you will see the two beams crossing each other. But a doubtful observer might say, "How do we know that one beam doesn't turn into the other?" In other words, how do we know that beam "A" remains completely unaffected by beam "B"? One way to prove that the beams do not interfere with each other is to put a piece of green cellophane over one, and a piece of red cellophane over the other. The beams will now have different colors, and if you let them hit a distant screen, you will observe that even though they cross, the one that started off green, ends up green, and the one that started off red, ends up red. In other words, light waves can cross without affecting one another.

9. How about two sets of waves on the surface of water? If you set up one set of ripples with one burnt-out light bulb and another set with another burnt-out light bulb, will one set of ripples go through the other without affecting it? Observation will show that in the region where they are crossing, they do affect each other. But once they have passed through this region, they continue along unchanged. Waves can pass through one another without permanently affecting each other.

Correlated References for Students and Teachers

TEXT REFERENCES FOR STUDENTS

Barnard, Stendler and Spock
Macmillan Science/Life Series, Book VI
The Macmillan Co., 1960
Unit 4, pp. 81-105

Barnard, Stendler, Spock and Beeler
Science: A Search for Evidence, Grade 7
The Macmillan Co., 1960
Unit 5, pp. 134-147

Beauchamp, Mayfield and West
Science Problems—2, Grade 8
Scott, Foresman and Co., 1957
Unit 1, pp. 4-39

Beauchamp, Mayfield and West
Science Problems—3, Grade 9
Scott, Foresman and Co., 1957
Unit 2, pp. 55-59
Unit 4, p. 213

Beauchamp, Mayfield and West
Everyday Problems in Science, Grade 9
Scott, Foresman and Co., 1957
Unit 17, pp. 412-414
Unit 18, pp. 441-460

Carroll, Adams and Harrison
Science in the Universe, Grade 9
John C. Winston, Co., 1958
pp. 239-248

Craig and Urban
Science Today and Tomorrow Series,
Book VIII
Ginn and Co., 1958
pp. 254-281

Frasier, MacCracken and Decker
Our Scientific Needs, Grade 7
L. W. Singer Co., Inc., 1956
Unit 4, pp. 141-145

Jacobson and Lauby
ABC Science Series, Book IV
American Book Co., 1961
pp. 199-203

Schneider, Herman and Nina
Heath Elementary Science Series, Book VI
D. C. Heath and Co., 1959
pp. 1-74

Thurber, Walter A.
Exploring Science Series, Book VI
Allyn and Bacon, Inc., 1960
pp. 151-178

SUPPLEMENTARY READING FOR STUDENTS

Pierce, John R.
Electrons, Waves and Messages
Hanover House, 1956

REFERENCES FOR TEACHERS

Blackwood, Herron and Kelly
High School Physics
Ginn and Co., 1958
Chapter 21, pp. 356-366

Brinckerhoff, Cross, Watson and Brandwein
The Physical World
Harcourt, Brace and Co., 1958
Chapters 28-29, pp. 319-347

Dull, Metcalfe and Williams
Modern Physics
Henry Holt and Co., 1960
Unit 5, chapter 12, pp. 269-284

Mallinson, Mallinson and Welch
General Physical Science
McGraw-Hill Book Co., Inc., 1961
Unit 10, chapters 33-34, pp. 533-575

Marburger and Hoffman
Physics for Our Times
McGraw-Hill Book Co., 1955
Unit 3, chapter 11, pp. 256-279

Physical Science Study Committee
Physics
D. C. Heath and Co., 1960
Chapter 16, pp. 248-259

White, Harvey E.
Physics: An Exact Science
D. Van Nostrand Co., Inc., 1959
pp. 257-296, 459-468, 494-499

Energy - I. (continued)

Name and Description of Film	Other Grade Placements	Remarks
3. Learning About Heat ** EBF, 1958; 8 min., black & white Identifies and describes the characteristics of heat. Points out that hands get cold because heat, not cold, is transferred. Uses animation to explain expansion and contraction according to the theory of molecular activity as a solid is changed to a liquid and then to a gas. Discusses the three methods of heat transference and ends with a review of the concepts.	Gr. 9 - *	
4. Thermometers and How They Work EBF, 1963; 10 min., color Different kinds of thermometers and their uses are shown. A thermometer is made with colored water, a bottle, and a glass tube. When it is placed in a pan of hot water the liquid rises in the tube, demonstrating expansion; contraction is illustrated by placing the thermometer in cold water and watching the liquid go down again. Thermometers and their purposes are demonstrated. Heat is measured by the thermometers on a food freezer, a car dashboard. Thermometers are used for cooking, and in sick rooms; they are used by doctors, weather forecasters, fishermen, and by lifeguards at the beach.		No eval. yet

* Good
** Excellent

III. Energy

G. Electrical energy

Name and Description of Film	Other Grade Placements	Remarks
1. Electricity: How to Make a Circuit ** EBF, 1960; 11 min., color Demonstrates the use of the dry cell in experimenting with electrical circuits. Shows three children setting up a telegraph key and bell between a tree house and one of the boy's bedrooms. Describes how a circuit is made, how a switch can be used to make or break a circuit, and how defective wiring causes a short circuit. Reviews the concepts covered and shows the children setting up a two-way signal system.		
2. Electromagnets ** McGraw-Hill 1962; 11 min., color Explains the principle of electromagnetism, and shows how electromagnet is used in doorbells, telephones, telegraph sets, and electric motors.		
3. Electromagnets: How They Work ** EBF, 1960; 11 min. Shows through laboratory experiments how an electromagnet is used, how it is constructed and how its strength can be increased.		
4. Exploring Electromagnetic Energy ** Film Assoc. of Calif., 1961; 14 min., color Discusses electromagnetic energy and describes some of the ways in which it is used. Explains that radio waves, infrared, visible light, ultraviolet, x-rays, and gamma rays are all members of the same family.	Gr. 9 - ** Gr. 11 - *	

* Good
** Excellent

Energy - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
5. The Flow of Electricity ** Young America, 1946; 10 min., black & white Two children learn about the factors which affect the flow of electricity through a simple electrical circuit. Introduces the electron theory, and shows the application of a simple circuit in a home situation.	Gr. 9 - ** Sci. II - *	
6. How Electricity is Produced ** Pat Dowling, 1960; 11 min., color Explains that electricity is produced in three ways--by friction, by chemical action, and by magnetic action. Depicts Faraday discovering the principle of an induced current, and demonstrates with a small magneto generator the principle of current electricity. Uses photographs of a hydro-electric plant to show how mechanical energy is converted into electrical energy, using the principle discovered by Faraday.	Gr. 9 - *	
7. How to Produce Electric Current With Magnets ** EBF, 1961; 10 min., color The magnetic effects of an electric current are demonstrated. Electromagnets are made and what they can do is illustrated. A coil of copper wire is connected to an electric meter and a magnet is brought near. The magneto on a motor scooter is explained. The transition is made from permanent to temporary magnets to generate electric current as at the Hoover Dam Powerhouse.	Gr. 9 - **	

* Good
** Excellent

Energy - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
8. Introduction to Electricity ** Coronet, 1948; 11 min. Introduces the basic principles of electricity. Investigates, through the interests of two students, static and current electricity, showing how the natural repulsion of electrons makes electricity with chemicals and with magnetic lines of force.	Gr. 9 - * Gr. 6 - *	
9. Learning About Electric Current ** EBF, 1958; 8 min., black & white Describes characteristics, uses and dangers of electric current. Circuits, conductors, insulators, fuses, and switches are explained both in animation and in simple demonstration, and the electricity used in the home is traced back to the generators in power plants.	Gr. 9 - *	For slower group
10. Magnetic, Electric, and Gravitational Fields ** EBF, 1961; 11 min. Uses animated drawings with live-action scenes to define the characteristics of fields and to illustrate their practical applications. Shows the effects of a magnetic field on a compass needle, of the earth's gravitational field on the moon's orbit, and of electric fields on materials such as wood, glass, and steel.	Gr. 4 - ** Gr. 9 - ** Gr. 6 - **	

* Good
** Excellent

How to Produce Electric Current with Magnets

Film Summary

We look at a small balance. A copper strip runs around one end of the balance and is attached to a battery and a switch. A permanent magnet has no effect on the balance until the switch is closed and electric charges flow through the copper strip. Now the balance is repelled by the magnet with enough force so that weight has to be put on the other end of the balance to make it balance again.

A magnetic needle removed from a compass can be made to move by another magnet. When the needle is placed under a wire and electric charges are made to flow through the wire, the needle moves again. Electricity and magnetism seem to have some connection with each other.

Now we see a simple electromagnet being put together. A non-magnetic iron core is placed inside a coil of wire. When electric charges are made to flow through the coil of wire, the electromagnet can pick up iron and steel objects. The electromagnet acts as a magnet only as long as electricity is flowing through it. Electric currents can produce magnetic effects. Is the opposite true? Can magnets produce electric currents?

A coil of wire is attached to a meter. There are electric charges in the wire and the meter, but nothing is making them move, so there is no electric current. When a permanent magnet is brought close to the coil, current flows for a moment as indicated by the meter. When the magnet is moved away, current flows again, and in the opposite direction. When the magnet is moved in and out over and over again, a fairly continual current is produced.

What makes the headlight in a motor scooter burn? There is no battery. But there are magnets and coils. We see in a close-up view how the turning motor of the motor scooter causes the magnets to move past the coils, producing an electric current that makes the headlight light.

In a small hand generator the process is reversed, but the result is the same. In the generator, the coils move past stationary magnets, producing enough electric current to light a bulb.

Instead of using permanent magnets and coils to produce electric current, we can use electromagnets and coils. The electromagnets can be moved in and out, or can simply be turned on and off. When the electromagnet is turned off, its magnetic strength is weak. When it is turned on, the strength is great, and this produces the same effect on the coil as moving the electromagnet in and out. We see that by turning an electric current on and off in one circuit, we can produce an electric current in another circuit.

Now we see the generators inside the powerhouse at Hoover Dam. These huge generators work on much the same basic principle as the simple experimental generators we have seen. Magnets and coils are moving in relation to each other. They are producing a great deal of electricity, enough to light a city.

Introduction to the Film

The basic concept of this film is that electricity and magnetism are interrelated. We want to show that an electric current can produce magnetic effects, but, even more important within the framework of this particular area of study, that magnets or magnetic fields can produce electric current.

It is fairly easy to show that a coil of copper wire which does not behave like a magnet at all, suddenly acts like a magnet when there is an electric current in it. Demonstrating the inverse effect, the production of an electric current with magnets, requires equipment which is not readily available in the classroom. The very instructive and dramatic experiments made by Faraday, which show that moving a magnet in relation to a coil of wire will cause electric charges to flow in the coil, require an extremely sensitive type of meter to measure the very minute current. Therefore, many of the demonstrations presented in the film cannot easily be repeated by the teacher. Accordingly, the experiments in the film should be noted carefully, talked about, and seen on the screen more than once.

An important concept to keep in mind is that the electric charges made to move by a generating device are already in the wires of the circuit. The generator does not supply these electric charges. For example, an electric current is produced in the film by moving a magnet back and forth in relation to a coil of wire. The magnet is moved close to the coil, and then moved away—close to the coil, and away, and so on. A meter connected to the coil shows that when the magnet is moving, an electric current is established. But the magnet never touches the coil. The electric charges which are moved by the magnet, and in moving, constitute an electric current, are already in the coil of wire. In the same way, the electric charges moved by the huge generators supplying electric current for a city are already in the wires that run from the powerhouse to your house, and in the wires inside your house, and in the appliances connected to those wires. All the generator does is to make these electric charges move.

If it can be done, it will be valuable to show your class working generators in operation. Nearby farms may be equipped with small gasoline generators. In some of these, it will be possible to see the magnets and the coils. There will probably be a gasoline generator used as a source of emergency power in your local hospital. One of your students may have a small magneto (generator) mounted on his bicycle. If the student is willing, this generator can be opened to expose the magnets and coils. If there is a power-generating station in or near your city, it will be most worth while to arrange to take your class there on a field trip. You will not be able to see the magnets and coils exposed in the big generators in the powerhouse, but you will be able to see that a turning motion is involved. Magnets are being moved in relation to coils to produce electricity.

Demonstration To Be Presented Before Showing the Film

The equipment required consists of a roll of thin copper insulated wire, a #6 dry cell (the type used for doorbells), a couple of large nails, and some paper clips. First, wrap 20 or more turns of wire around the nail. Remove the nail and connect the wire to the dry cell momentarily. See if the coil of wire can pick up a paper clip. (It may or may not be able to do so, depending on the number of turns and the strength of the dry cell.) Now put the nail back into the coil and repeat the experiment. This time, the electromagnet should easily be able to pick up a few paper clips and a nail or two. Unhook one of the wires from the dry cell and the paper clips and nails will fall. Point out that you have used electric current to make a magnet. Raise the inverse question. That is, is it possible to use magnets to make electric current?

Experiments and Projects

1. Here is a simple exercise in logic. I like Mary, and I like Joe. Does that guarantee that Mary likes Joe? A similar question can be raised about magnetism. Here we need a compass needle and two bar magnets. Suppose you discover that end B of one magnet attracts end A of the compass needle, and then you discover that end C of another bar magnet also attracts end A of the needle. Question: Will B attract C? There's only one way to find out, and that's by doing the experiment. Push end B and end C together. Do they attract each other or do they repel each other? (They will repel each other.)

2. An interesting way to demonstrate the strong repulsive forces which magnets can exert on one another is to take two cylindrical bar magnets and place them on an inclined plane which can simply be a tilted board. If you arrange the two magnets so that they repel each other, then you can push the upper magnet uphill simply by approaching it with the lower magnet. The two magnets will always stay about the same distance apart. If you force the two magnets together, then release them, they will fly apart as if pushed by a spring. These experiments give a clear indication that a

magnet is surrounded by an area in which its magnetic effects can be felt. Magnets do not have to touch things to affect them.

3. The fact that the different ends of a bar magnet have different effects on a compass needle is attributed to the existence of "poles" at each end. We know today that this is a fiction, but it is a useful fiction, and we still speak of the north and south poles of a magnet.

Find out what direction north is in your classroom and draw a line on the floor pointing north. Next, suspend a bar magnet in the middle of the room so that it is free to move in a horizontal plane. (See FIGURE ONE, page 23.)

Allow the hanging magnet to come to rest. Does the magnet end up parallel to the line you have drawn on the floor? It should, pretty nearly, unless there are iron pipes or other magnetic influences nearby. The end of the magnet that points north is *arbitrarily* called the north pole of the bar magnet. (It really should be called the north-seeking pole.)

4. In magnetism you always get north and south poles together. A magnet always has one of each. To demonstrate this, get a piece of steel piano wire about six inches long and magnetize it by stroking it against the strongest magnet you have. If you draw the steel wire along the poles of the strong magnet, repeating the procedure in the same way several times, you may find that the wire has become permanently magnetized, as you can prove by bringing it close to a compass needle. Observe that the newly magnetized steel wire has poles; that is, one end repels and the other end attracts a given end of the compass needle. Now, with a pair of strong wire-cutting shears, cut the wire in half. Try each half with the compass needle. You will find that each half has two poles. Cut the halves in half and see if the new pieces have two poles each.

5. This will be a repetition of *Oersted's classical experiment* to show that there is a relation between electricity and magnetism. You will need a dry cell, a long piece of copper wire, and a compass. Let the compass needle come to rest in the earth's magnetic field. Get two students to stretch a wire so that it is parallel to the needle and directly above it. Another student completes the circuit by touching the two ends of the wire to the posts of the dry cell momentarily.

NOTE: If the wire were connected firmly to both posts, this would constitute a *short circuit*. What happens then is that a very large current will be drawn from the dry cell and the dry cell will be ruined in a short time. What is more, the wire will get hot. Therefore, in this experiment, you simply want to complete the circuit for a moment and observe what happens to the needle when you do. Does the needle turn? Which way does it turn? Now repeat the experiment with the ends of the wire reversed — that is, going to the opposite posts of the dry cell. Does the needle swing the other way now?

6. If a pair of earphones is available, it can be used in place of a sensitive meter to prove that magnets can produce electric currents. Any kind of earphone can be used. The electric current will be weak, but because the earphones are very sensitive they can detect it. Coil wire around an iron nail "A" and wrap another coil of wire around another iron nail "B" and separate the two nails with a piece of cardboard. Connect the ends of the wire around nail "B" to the pair of earphones. If the earphones have a single plug, one wire should be taped to the end of the plug, the other to the side of the plug. There is no dry cell in circuit B. Connect one end of the wire around nail "A" to a dry cell. (See FIGURE NINE.) When the other end of the wire around nail "A" is touched to the other post of the dry cell, nail "A" becomes a magnet. What happens to nail "B"? Put on the earphones and complete

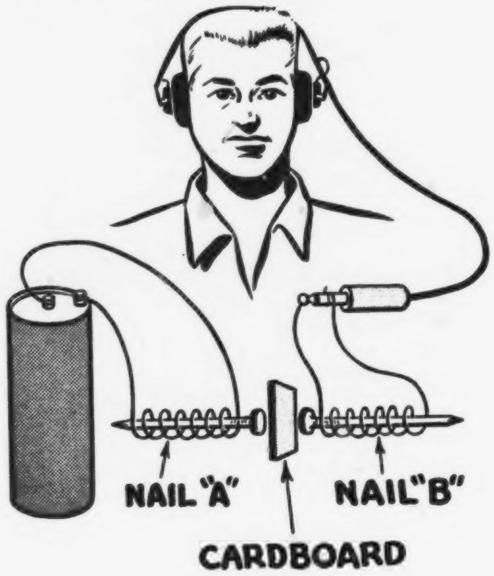


FIGURE NINE

the circuit that makes nail "A" an electromagnet. You will hear a click. The magnetic field suddenly created in nail "A" generates an electric current in nail "B" which makes an audible click in the earphone. The click is heard only when the circuit in A is either completed or broken. In other words, only a changing magnetic field in A produces electrical effects in the earphones. The effects are so weak that it is almost impossible to believe that similar effects produce large enough currents to drive electrical machinery for a whole city. But that is the basic idea.

Correlated References for Students and Teachers

TEXT REFERENCES FOR STUDENTS

Barnard, Stendler and Spock
Macmillan Science/Life Series, Book VI
The Macmillan Co., 1960
Unit 11, pp. 304-310

Beauchamp, Mayfield and West
Science Problems—1, Grade 7
Scott, Foresman and Co., 1957
Unit 7, pp. 236-240

Beauchamp, Mayfield and West
Science Problems—3, Grade 9
Scott, Foresman and Co., 1957
Unit 3, pp. 129-150

Beauchamp, Mayfield and West
Everyday Problems in Science, Grade 9
Scott, Foresman and Co., 1957
Unit 16, pp. 386-390, 396-398

Carroll, Adams and Harrison
Science in the Universe, Grade 9
John C. Winston Co., 1958
pp. 236-238

Craig and Urban
Science Today and Tomorrow Series,
Book VIII
Ginn and Co., 1958
pp. 308-340

Frasier, MacCracken and Decker
Singer Science Series, Book V
L. W. Singer Co., Inc., 1959
pp. 245-256

Frasier, MacCracken and Decker
Our Scientific Needs, Grade 7
L. W. Singer Co., Inc., 1956
pp. 399-424

Jacobson and Lauby
ABC Science Series, Book V
American Book Co., 1961
pp. 213-269

Schneider, Herman and Nina
Heath Elementary Science Series, Book IV
D. C. Heath and Co., 1956
pp. 249-257

Schneider, Herman and Nina
Science In Our World, Book V
D. C. Heath and Co., 1955
pp. 273-276

Thurber, Walter A.
Exploring Science Series, Book VI
Allyn and Bacon, Inc., 1960
pp. 207-226

SUPPLEMENTARY READING FOR STUDENTS

Atkin and Burnett
Electricity and Magnetism
Rinehart, 1958

Bitter, Francis
Magnets
Doubleday Anchor Books, 1959
Wesleyan University Press

Skilling, H. H.
Exploring Electricity: Man's Unfinished Quest
The Ronald Press Co., 1948

REFERENCES FOR TEACHERS

Blackwood, Herron and Kelly
High School Physics
Ginn and Co., 1958
Chapters 31, 32, pp. 499-553

Brinckerhoff, Cross, Watson and Brandwein
The Physical World
Harcourt, Brace and Co., 1958
Chapter 22, pp. 244-257

Dull, Metcalfe and Williams
Modern Physics
Henry Holt and Co., 1960
Unit 7, chapter 21, pp. 462-485
Unit 8, chapter 22, pp. 487-519

Mallinson, Mallinson and Welch
General Physical Science
McGraw-Hill Book Co., Inc., 1961
Unit 10, chapter 30, pp. 475-492

Marburger and Hoffman
Physics for Our Times
McGraw-Hill Book Co., Inc., 1955
Unit 4, chapter 17, pp. 388-421

Physical Science Study Committee
Physics
D. C. Heath and Co., 1960
pp. 548-571

White, Harvey E.
Physics: An Exact Science
D. Van Nostrand Co., Inc., 1959
pp. 415-426

Energy - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
11. Making Electricity ** EBF, 1949; 11 min., black & white Demonstrates how electricity is made by moving a coil of wire through the field of a magnet. Explains how a small, hand-powered generator is constructed and how it operates; illustrates how the same principle applies in generating electricity at a large hydroelectric plant; and reveals how electricity is carried over power lines to the consumer.	Gr. 3 - ** Gr. 9 - **	For mature groups
12. Safety With Electricity EBF, 1963; 10 min., color An electric storm, a fallen high voltage wire, a lightning-felled tree dramatize the force of electricity. A boy plays with an electric train, turns a wall switch on and off, and plugs in appliances to illustrate the uses of electricity. Simple experiments demonstrate how electricity is conducted. Through animation a short circuit is illustrated; a fuse blows, tinsel melts when laid across bare wire, an overloaded circuit is shown. Electricity is seen as a friend. Children are cautioned not to make it a dangerous enemy.		No eval. yet
13. Series and Parallel Circuits * EBF, 1944; 11 min., black & white Clarifies the relationships between resistance, current, and electromotive force in series circuits and in parallel circuits, and demonstrates the advantages and disadvantages of both types of circuits. Describes a simple series-parallel combination and offers examples.	Gr. 9 - **	Mature films

* Good
** Excellent

Energy - G. (continued)

Name and Description of Film	Other Grade Placements	Remarks
14. Watch Mr. Wizard **	Gr. 9 - **	

Gen. Foods, 1952; 30 min., black & white

Electromagnetism is magnetism developed by a current of electricity. An electromagnet is a core of magnetic material on which is wound a coil of wire through which an electric current is passed. The strength can be changed by changing the number of coils or the core material. A circuit is defined. Remaining ideas in film are health, not science.

Name and Description of Film	Other Grade Placements	Remarks
15. What is Electric Current? **	Gr. 9 - **	

EBF, 1962; 13 min., color

Although you can't see the flow of electric current as you can see the flow of running water, there is circumstantial evidence that electricity behaves somewhat like water in a pipe. To demonstrate effects of electric current, the film uses a simplified circuit connecting an automobile battery with headlights, a horn, and a starter motor. Experiments show that electricity flows only when it has a complete pathway or circuit, and that it can flow in either direction in a circuit.

* Good
** Excellent

What Is Electric Current?

Film Summary

A battery in a car is a source of electric current which permits us to have light, heat, and power. Light in the headlights, heat in the cigaret lighter, and power in the starter motor. We go into a house and see that house current also permits us to have light, heat, and power. But house current is too dangerous to experiment with. Instead, we can use the battery.

Connected to the battery in a simplified circuit are headlights, a horn, and a starter motor. Three switches permit each to be turned on separately. A meter is also included in the circuit. We see that there is a meter reading when current is flowing in the circuit.

We look at a lawn sprinkler. There is something flowing here, and unlike the flow of electricity, we can *see* the flow of water. A meter, similar in appearance to the electric meter, indicates when water is flowing through a pipe. When more sprinklers are turned on, more water flows through the pipe, and the meter reading is higher. In the electric circuit, the more things that are turned on, the higher the meter reads. This is one piece of evidence to suggest that there is something flowing through the wires that acts in one way, at least, like water flowing through a pipe.

By reversing the wires to the battery, we see that electricity seems to have a direction of flow. With the wires one way, the meter kicks over to the right; with the wires reversed, the meter kicks over to the left.

Now we look at a circuit in which there are several thousand feet of wire between the battery and a pair of headlights. There are two meters in the circuit, one on either side of the long length of wire. The electricity flows through one meter and then through all the wire before it flows through the second meter. But when the circuit is completed, both meters kick over at the same time.

Now we look at a similar circuit in which water can flow. Instead of wire, we have clear garden hose. There are two meters that kick over when water flows through them. And there is a pump to force water out of a reservoir through the circuit. When the pump is turned on, the water passes through one meter, makes it kick over, passes through the length of hose and then through the second meter, making it kick over several seconds later.

Now the water circuit is full of water. When the pump is turned on again, water moves everywhere in the circuit at just about the same time, and the meters kick over at the same time.

We look again at the similar electric circuit. When the switch is closed and electricity flows, both meters kick over at the same time. Isn't it logical to think that whatever it is that flows in an electric circuit is already in the wires? That would explain why both meters kicked over at the same time, as they did in the water circuit when it was full of water.

Now we look at a length of copper wire attached to a meter and an electroscope. When a plastic coat hanger is rubbed with silk and brought close to the end of the wire, the meter kicks over and the gold foil leaf of the electroscope flies away from its support. This is another piece of evidence indicating that whatever it is that flows in an electric circuit, is already in the wire. The coat hanger did not have to touch the wire to produce an electric current.

A group of boys and girls join hands to make a complete circuit between a weak battery and a meter. A current flowing through their bodies is registered on the meter. This is one piece of evidence to suggest that electric charges (the stuff that flows in an electric current) can be found in all materials, not just in such things as wires.

Introduction to the Film

An electric current is a flow of electric charges. But what is an electric charge? In this film we will not attempt to define what an electric charge is. Even if we could supply a definition, it probably would not have very much meaning. In another film we will indicate that tiny particles called electrons are the smallest units in nature carrying an electric charge. But in this film we will demonstrate only that there seem to be electric charges in all materials and that an electric current is a flow of something. We will define this "something" as electric charge.

Imagine a simple electric circuit: a dry cell, a small light bulb, a switch, and wires connecting them all together. When the switch is closed, the bulb lights. When the switch is open, the bulb does not light. There is electric current in the circuit only when the circuit is complete. If electric current *is* a flow of electric charges, then these charges seem to flow only when they have a complete circular path to flow through. But even when the switch is closed and the circuit is complete, and the burning light bulb indicates that there is an electric current in the circuit, can you really *see* anything flowing? Of course not. If we are to prove that something flows when there is an electric current, we will have to use indirect proof to do it.

Imagine another circuit. This one consists of a pump and a length of clear plastic tubing. The tubing is filled with water. When the pump is turned on, it circulates the water through the loop of tubing. In other words, the pump makes the water flow around and around the circuit of clear plastic tubing. Can you see the water flow in this circuit? Probably, if you look closely. You will probably be able to see some bubbles moving, or the movement of impurities carried along by the water through the tubing. But what if the water were absolutely clear and had no bubbles in it? Could you look at the circuit then and tell that something was flowing? You would have to infer that the water was flowing by observing what it could do in transit. For example, if a simple paddle-wheel device were included in the circuit, you could tell that water was flowing because you would observe the effect it had on the paddle wheel. You would see the wheel turn.

Several demonstrations in the film indicate that there are some similarities between the flow of water in pipes and the flow of electric charges in wires. In the same way that we observed the effect of the "invisible" water on the paddle wheel, we infer that something is flowing in the electric circuit by observing effects. A light bulb in the circuit lights because electric charges flow through its filament. An electric motor in the circuit turns because electric charges flow through it.

In the film, a visual comparison between the flow of water in a pipe and the flow of electric charges in a wire is also used to demonstrate another important concept about electric current. The electric charges that flow in the circuit with the dry cell and the light bulb do not come from the dry cell; they are already in the wires of the circuit. The dry cell is simply a device that can make them move. The dry cell acts in much the same way as the pump in the water circuit. The pump moves water that is already in the pipes and makes it flow around the circuit. The pump does not supply the water. In the same way, the dry cell moves electric charges that are already in the wires and causes them to flow around the circuit. The dry cell does not supply the electric charges to the circuit.

When experimenting with electricity it must always be kept in mind that electricity *can be dangerous.* To touch wires connected to house current *can very well be lethal.* Therefore, all experiments with electricity should be made using low-voltage devices such as dry cells. The most common dry cells are those used as batteries for flashlights. But flashlight batteries do not have posts to which it is easy to connect wires. #6 dry cells have screw-on binding posts to which wires can be easily connected. This type of dry cell is cylindrical and about six inches tall. Its voltage is one and a half volts. You can touch the two posts of such a dry cell with your fingers without any danger.

NOTE: Pinning the needle of a meter—that is, allowing the needle to swing hard all the way to one side of the scale, can permanently damage the meter. Meters are allowed to pin in this film for purposes of demonstration. But it should not be construed from the film that pinning meters is good laboratory practice.

Demonstration To Be Presented Before Showing the Film

Show the class a simple circuit: a #6 dry cell and a small light bulb and socket are wired together. The bulb is not lit because one of the wires is not attached to the dry cell. Ask the class why the bulb is not burning. Connect the remaining wire. The bulb lights. Ask the class why the bulb lights now. What is making it light? Disconnect a wire anywhere in the circuit. The bulb goes out. Ask the class why. Why does the circuit have to be complete? Is there something flowing through the circuit?

Experiments and Projects

1. This experiment will require a dry cell, two lamps in sockets, and some wire.

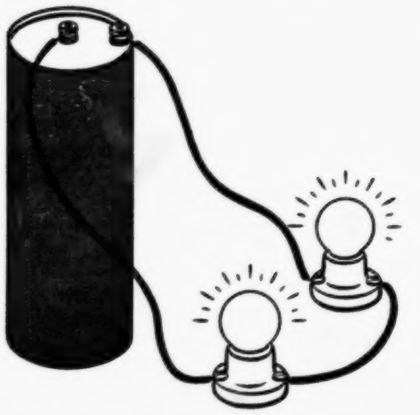


FIGURE SIX

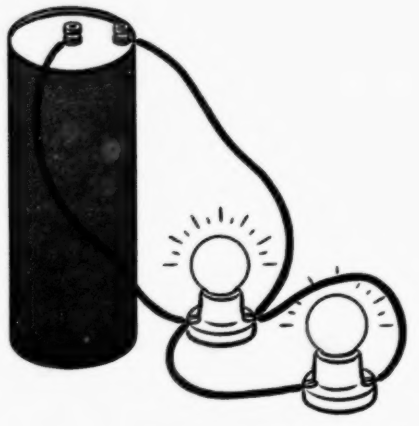


FIGURE SEVEN

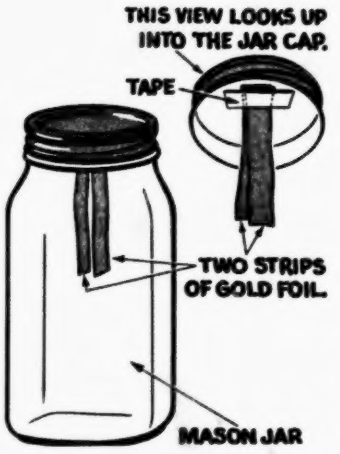


FIGURE EIGHT

Make a circuit by attaching a wire from the dry cell to one of the sockets, another wire from that socket to the second socket, and a third wire from the second socket back to the other post of the dry cell. When both lamps are screwed in, do they both light? If one lamp is unscrewed, do both lamps go out? Why? Use the circuit to explain why. (See FIGURE SIX.)

2. Now use the same equipment wired in a different way. Attach a wire from the dry cell to the first socket, and another wire from the first socket back to the dry cell. Now attach a second wire to each post of the first socket, and run the wires to the posts of the second socket. Screw in both bulbs. Do they both light? Unscrew one bulb. Does the other bulb go out too? Why not? Use the circuit to explain why. (See FIGURE SEVEN.)

3. The three principal effects of electric current are heat, magnetism, and chemical effects. We have already seen how electric current can produce heat. The bulbs in the previous experiment produced light because their filaments got hot. In other films we will see how electric current can produce magnetic effects. A simple demonstration to show a chemical effect of electric current requires a dry cell, some wire, and a potato. Slice a raw potato. Run a wire from one post of the dry cell to the potato. Simply stick the uninsulated end of the wire into the potato. Now stick another wire into the potato (make certain that the two wires in the potato do not touch) and attach the other end of this wire to the other post of the dry cell. Now you will have to wait several minutes. Look closely at the two wires stuck into the potato. Around one of them, the potato will be turning dark. The blackening is due to a chemical change caused by electric current. Reverse the wires to the dry cell and wait several minutes more. Now the potato should be blackened around the other wire. This is a good hint that electric charges can be made to flow in either direction through a circuit.

4. A simple yet very sensitive device for detecting the presence of electric charge is the gold-leaf electroscope. This is the "gadget" shown in the film in which there is a gold-foil leaf which flies away from its support when electric charges are pushed onto it. It is possible to construct a home-made electroscope which can be just as sensitive and useful as the one used in the film. Gold foil can be purchased from scientific supply houses or from sign-painting establishments. You will need very little of it. Two strips one-half inch wide and an inch and a half long will be plenty. You will also need a common mason jar with a metal top and some tape. And that's all. First, attach the two strips of gold foil to the inside of the metal top of the mason jar. If there is any insulating material—waxed cardboard, for example—on this inside surface, remove it. Tape the two strips of gold foil to the metal top so that when the top is placed on the mason jar, the two strips will hang down touching each other along their surfaces. (See FIGURE EIGHT.)

NOTE: Because the gold foil is so thin, it must be handled with extreme care. Even the slightest breeze will move it, and it is likely to stick to itself or to anything it touches. It is helpful to tie a handkerchief over your mouth and nose so that your breath will not disturb the gold foil as you work with it. Once the gold-foil strips hang inside the mason jar, they will be protected from air currents. Rub a plastic comb with a silk cloth. Bring the comb close to the top of the mason jar. Inside, the two gold-foil leaves should spread apart. Try rubbing various objects with silk or wool or fur. Bring them close to the top of the electroscope. How do these objects affect the leaves of the electroscope?

5. Two perfectly dry glass milk bottles will be used in this experiment as insulators, similar to the glass insulators on telephone poles or power lines. Place the two bottles

three feet apart. Take a long piece of uninsulated copper wire and twist it around the neck of each milk bottle so that it hangs suspended between them. One end of the wire should be long enough so that it can be connected to your gold-foil electroscope. Simply tape the end of the wire down to the top of the mason jar. When a plastic coat hanger that has been rubbed with a wool cloth, or when any other charged object is brought near the distant end of the wire, the leaves of the electroscope will fly apart, even though the coat hanger does not touch the wire. Experiments of this sort indicate that the electric charges are already in the wire. Now repeat this experiment using a piece of dry thread instead of the copper wire. Do the leaves spread apart this time? Repeat a third time after wetting the string with salt water. You may have to wait a little while to observe the leaves spreading. *But they will spread.* Why?

6. This experiment should be made with the copper wire suspended between the two milk bottles and attached to the gold-foil electroscope as above. Observe these instructions carefully. Bring the charged coat hanger near the distant end of the wire. The leaves fly apart. Holding the coat hanger nearby but not touching the wire, touch the wire momentarily with a finger. That should cause the leaves to collapse even though the coat hanger is still nearby. Now, remove the coat hanger and the leaves should fly apart and stay apart. We will not go into an explanation of all the details. All we want to do now is to put a charge on the electroscope leaves. Now the experiment begins. Simply touch the distant end of the wire with your finger. The leaves collapse. The electric charges that made the leaves spread have flowed along the wire and out through your body. In other words, your body can conduct electricity.

Correlated References for Students and Teachers

TEXT REFERENCES FOR STUDENTS

Barnard, Stendler and Spock
Macmillan Science/Life Series, Book IV
The Macmillan Co., 1960
Unit 9, pp. 247-255

Barnard, Stendler, Spock and Beeler
Science: A Search for Evidence, Grade 7
The Macmillan Co., 1960
Unit 5, pp. 148-154

Beauchamp, Mayfield and West
Science Problems—1, Grade 7
Scott, Foresman and Co., 1957
Unit 7, pp. 236-240

Beauchamp, Mayfield and West
Science Problems—2, Grade 8
Scott, Foresman and Co., 1957
Unit 7, pp. 256-288

Beauchamp, Mayfield and West
Science Problems—3, Grade 9
Scott, Foresman and Co., 1957
Unit 3, pp. 104-152

Beauchamp, Mayfield and West
Everyday Problems in Science, Grade 9
Scott, Foresman and Co., 1957
Unit 16, pp. 373-407

Carroll, Adams and Harrison
Science in Our World, Grade 8
John C. Winston Co., 1957
pp. 294-307

Carroll, Adams and Harrison
Science in the Universe, Grade 9
John C. Winston Co., 1958
pp. 212-222

Craig and Hurley
Science Today and Tomorrow Series, Book IV
Ginn and Co., 1958
pp. 164-183

Craig and Hill
Science Today and Tomorrow Series, Book V
Ginn and Co., 1958
pp. 202-225

Craig and Urban
Science Today and Tomorrow Series,
Book VIII
Ginn and Co., 1958
pp. 308-340

Dowling, Freeman, Lacy and Tippett
Understanding Science Series, Book V
John C. Winston Co., 1957
pp. 87-116

Frasier, MacCracken and Decker
Singer Science Series, Book IV
L. W. Singer Co., Inc., 1959
pp. 231-247

Jacobson and Lauby
ABC Science Series, Book V
American Book Co., 1961
pp. 213-269

Schneider, Herman and Nina
Heath Elementary Science Series, Book V
D. C. Heath and Co., 1955
pp. 286-308

Thurber, Walter A.
Exploring Science Series, Book V
Allyn and Bacon, Inc., 1960
pp. 162-184

SUPPLEMENTARY READING FOR STUDENTS

Beeler and Branley
Experiments With Electricity
Crowell Co., 1949

Block, Marie H.
Herbert, the Electrical Mouse
Julian Messner Co., 1953

Eaton, J. R.
Beginning Electricity
The Macmillan Co., 1952

Epstein and Epstein
The First Book of Electricity
Franklin Watts, Inc., 1953

Freeman, Ira M.
All About Electricity
Random House, Inc., 1957

Morgan, A. P.
Things A Boy Can Do With Electricity
Scribner, 1938

REFERENCES FOR TEACHERS

Blackwood, Herron and Kelly
High School Physics
Ginn and Co., 1958
Chapter 26, pp. 432-446, chapter 27,
pp. 447-461

Brinckerhoff, Cross, Watson and Brandwein
The Physical World
Harcourt, Brace & Co., 1958
Chapters 21 and 22, pp. 236-257

Dull, Metcalfe and Williams
Modern Physics
Henry Holt and Co., 1960
Unit 7, chapter 19, pp. 409-443

Mallinson, Mallinson and Welch
General Physical Science
McGraw-Hill Book Co., Inc., 1961
Unit 10, chapters 30, 31, pp. 475-510

Marburger and Hoffman
Physics for Our Times
McGraw-Hill Book Co., Inc., 1955
Unit 4, chapter 14, pp. 334-358

Physical Science Study Committee
Physics
D. C. Heath & Co., 1960
Chapters 27, 28, pp. 443-486

White, Harvey E.
Physics: An Exact Science
D. Van Nostrand Co., Inc., 1959
pp. 381-385, 405-409

IV. The Universse

A. Earth

Name and Description of Film	Other Grade Placements	Remarks
1. Big World * Educ. Horizons, 1960; 11 min., color Shows how we cannot always know the shape of an object by viewing only a small part of it. Answers the simple, direct questions of a child about the size, and shape, of our world. A primary globe is used by the child's father to discuss briefly the basic forms of land and water.	K - ** Gr. 1 - * Gr. 3 - **	Easy film 1st semester
2. Day & Night ** United, 1949; 9 min. The globe is shown revolving about the sun to explain the causes of day and night and why the sun appears to rise and set. Describes the effect of the earth's inclination toward the sun. Through animated diagrams demonstrates the relative position of earth and sun in June, September, December and March, and the reasons for unequal length of day and night over the earth at different times of the year.	Gr. 8 - **	
3. How to Measure Time ** EBF, 1961; 10 min. color, sd. A boy discovers that when he is bored, time moves slowly, but when he is excited, time goes by rapidly. We examine a pendulum clock, a wrist watch, the boy's heart beat, the rhythm of a jazz combo, the earth's circling the sun, the earth turning on its axis as periods of time. The stop watch is used to time a high hurdles race and electronic timers are introduced. (JHS)	Gr. 3 - ** Gr. 6 - *	

* Good
** Excellent

The Universe - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. How We Know the Earth Moves ** Film Assoc. of Calif., 1960; 10 min., color We have been told that the earth spins on its axis and that it travels around the sun. But how do we know these statements are true? This film demonstrates and explains the Foucault Pendulum by which the earth's rotation was first proved. The audience participates in an experiment that illustrates star shift, the method astronomers use to determine the earth's solar orbit.	Gr. 8 - **	
5. The Seasons ** United World, 1960; 10 min., black & white Explains why the seasons change during the year, discussing the slanting rays of the sun, the tilt of the earth's axis, the revolution of the earth around the sun, and the rotation of the earth on its own axis. Animation is used for the explanation which is given within the framework of an incident on a Christmas day in Vermont.		
6. What Makes Day and Night * Young America, 1947; 8 min., black & white Two children learn that the alternation of day and night is due to the rotation of the earth and not to the apparent movement of the sun around the earth.	Gr. 2 - **	

* Good
** Excellent

The Universe - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
7. Why Seasons Change *	Gr. 5 - Gr. 8 - **	Also listed I-G
EBF, 1960; 11 min., black & white		
Shows why seasons change, making use of animated drawings to show why the tilt of the earth gives us short days in winter and long ones in summer. Also explains why it is hot in summer and cold in winter. Follows also the orbit of the earth through a complete year.		

IV. The Universe

B. Moon

Name and Description of Film	Other Grade Placements	Remarks
1. A Trip to the Moon ** 16 min., sd., color 16 mm, EBF Shows an imaginary rocket as it takes off to the moon and hovers above it, explaining many facts necessary for an understanding of navigation to the moon. Combines animation and model photography to study the moon's surface, and shows in detail the craters and seas, ridges and mountains that can be seen from the earth.	Gr. 6 - ** Gr. 8 - ** Gr. 9 - **	

* Good
** Excellent

IV. The Universe

C. Sun

Name and Description of Film	Other Grade Placements	Remarks
1. The Nearest Star ** McGraw-Hill, 1961; 27 min., color To stimulate interest in science in general and geophysics - influence of the sun on man's physical environment.	Gr. 8 - **	
2. Our Mr. Sun * N. W. Bell Tele., 1960; 60 min., color This Frank Capra produced film, starring Eddie Albert and Dr. Frank Baxter, first describes ways in which ancient man looked to the sun as a god. It continues with more facts which man has discovered about the sun through centuries. The sun's conona, spots, and the explosions on its face are shown. Thermo-nuclear reaction, photosynthesis and the solar battery are explained. World's leading scientists contribute information.	Gr. 8 - **	
3. Portrait of the Sun ** Academy Films, 1960; 18 min., color A complete picture of the characteristics of the sun and of its importance to all living things on earth. The sun is really a star, our closest star - 93 million miles away. Light from the sun reaches the earth in eight minutes. The sun is so hot that all its elements are gases. The source of the sun's heat is atomic energy.		

* Good
** Excellent

IV. The Universe

D. Solar system

Name and Description of Film	Other Grade Placements	Remarks
1. Asteroids, Comets and Meteorites ** Film Assoc. of Calif., 1960; 10 min., color Asteroids, comets and meteorites are called the minor members of the solar system. This film shows: 1) how astronomers have learned about these objects traveling around the sun; 2) what each group looks like; and 3) the place of each group in the solar system. The film also illustrates the newest objects in the solar system...man-made or artificial satellites.	Gr. 8 - **	
2. Gravity ** Coronet, 1950; 11 min. Through a variety of everyday examples explains the force of gravity. Shows attraction in relation to mass and distance, and the effect of gravity on our solar system. Demonstrates and explains mutual attraction between all bodies.	Gr. 8 - ** Gr. 6 - ** Gr. 9 - **	For slow students
3. How We Explore Space ** 16½ min., color, $175. Film Associates of California Introduces the instruments astronomers use and the methods by which they obtain information about the objects in space. Includes what are, perhaps, the first color motion pictures ever taken of the planets.	Gr. 8 - **	

* Good
** Excellent

The Universe - D. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. Mars and Beyond ** Walt Disney, 1958; 30 min., color Discusses the temperature and atmosphere on the planets, and the conditions necessary to sustain life. Explains man's earliest concepts of the planets, particularly Mars. Pictures the possible surface of Mars and the ways in which plant and animal life may have adapted to conditions there. Describes an imaginary flight to Mars in an atom-powered space ship.	Gr. 6 - ** Gr. 8 - ** Gr. 9 - **	
5. Planets in Orbit (Laws of Kepler) * EBF, 1960; 10 min., black & white Traces the history of man's observations and beliefs about the universe. Discusses three discoveries of Johannes Kepler that revolutionized astronomy. Explains Kepler's three laws. Animated sequences.	Gr. 8 - **	
6. Solar Family * EBF, 1936; 11 min., black & white Presents an introductory study of the planets, their evolution, motions, sizes and satellites. Describes, through animated drawings, the evolution of the solar system according to planetismal hypothesis, and traces the real and apparent motions of the planets. Reveals special phenomena pertaining to certain planets, and describes the planetoids, Halley's comet, and the movement of the solar system in space.	Gr. 8 - **	

* Good
** Excellent

The Universe - D. (continued)

Name and Description of Film	Other Grade Placements	Remarks
7. The Solar System ** Coronet, 1951; 11 min. Presents the names of the planets, their relative sizes, and the forces at work in the solar system. Visualizes the immensity of distances between the planets and the sun through an actual scale model of the solar system. Demonstrates the relationship of the planets to each other; their orbits; differences between planets and stars; and gravitational attraction, light and heat.	Gr. 8 - **	Use as introduction
8. What is Space? ** EBF, 1961; 10 min., color Establishes a simple concept of space and answers various questions concerning space. Broadens the concept of space through the use of demonstrations and explanations of outer space and the amount of space (light years) between our planet and others. Points out that as yet no end to space is known.	Gr. 8 - **	

* Good
** Excellent

What Is Space?

Film Summary

We are in a field filled with rows of dish-type antennas. We hear the sound of the motors that turn these antennas, keeping them pointed at an object in distant space.

Next we go to the control room, where scientists are listening to radio signals picked up by these antennas. We hear what they hear: the sound of static. But this static has originated on stars billions of light years out in space. We look closely at a photograph of a distant star field. The sounds come from here, way out in space. But there is no need to go so far to look for space. There is space all around you. Everything you do takes space to do it in.

A traffic jam. Horns honking. There is not enough space here. But even when things are crowded, there is plenty of space close by. And we look up into the empty sky. Let's take a trip away from the earth and find out just how much space there is. We start the trip in a helicopter. Then we switch to a rocket. Now to continue our trip out through space away from the earth, we switch to imagination, backed up by knowledge man has collected about space.

We have to travel about 240,000 miles away from the earth before we meet another object in space, the moon. We see it pass by as it circles the earth.

By the time we are about 93 million miles away from the earth, we meet another object in space, the sun.

Now we are 23 trillion miles away from the earth. We cannot see the earth from here; the sun itself is little brighter than the other stars. And now we meet our next nearest neighbor in space, the star Proxima Centauri.

As we move farther away from the earth, we find that the star Proxima Centauri and our sun are only two stars in a great collection of stars. We pass through this collection of stars, which is called a galaxy. Now we see another galaxy similar to ours as photographed through a telescope. This galaxy is nearly two million light years away from the earth. A light year is a measure of distance, not time. It is the distance light can travel in a year, about six trillion miles. Our telescopes have found galaxies in space that are six million light years away from the earth, and there is no reason to think that space does not extend farther than that.

Have we explored all the space there is? We have not. How about the space in a rock, for example? The rock seems solid, but does that mean that there is no space in it?

Now we go to the laboratory. A container is filled with marbles. But does that mean that there is no space in it? No, there is plenty of space for some BB's; they can fit in the space around the marbles. Even after the container is filled to the top with BB's, there is plenty of space left in it for some water.

Now we see two small bottles filled with water. When both are poured into a large bottle, they fill it with water up to a marking line. Now, one of the small bottles is filled with water and the other with alcohol. When the water and alcohol are poured into the large bottle, the mixture does not come up to the line. Why not? Is it possible that there is space inside the water or the alcohol?

We watch some boys playing catch and ask about the space between things. Is that space empty? The space between the boys playing catch is not empty; there are baseballs passing through it. How about the space between a spotlight and the place where its light hits? Again, that space is not empty, it is full of light. How about the space between the sun and the earth? No, that space is not empty, either, it is full of light and heat that passes from the sun down to us on earth.

We go back to the monitoring station we visited at the beginning of the film. We hear the signals that originated in stars billions of light years away, passing through all that space to reach us on earth. Suddenly, the sound of the static changes. A regular signal is superimposed on it. Such a signal has never been received from outer space. But what if someday, somewhere, such a signal were heard by men listening to the stars? What would such a signal mean?

Introduction to the Film

We read every day in the newspapers about the importance of *space exploration*. We hear our age referred to as the "Space Age." But if you tried to pin a person down with the question, "What *is* space?" you might find it difficult to get an answer. Many people want to explore space but very few can tell you what it is.

Three of the most important words in science are space, time, and matter. Everybody knows in a vague sort of way that they are related. For example, most people would grant that there is space between the earth and the moon, that the moon is made of matter, and that it would take time to move from the earth to the moon. It's when we try to be precise about these words that we run into difficulty.

This film is an attempt to say something that we can understand about space. For example, it's not hard to measure the distance between things, and that is some sort of measure of space. It is important to get some idea of how the distance between the earth and the moon differs from the distance between the earth and the sun, and, in turn. how this differs from the distance between the earth and the next nearest star. The enormity of astronomical space is something we want to grasp. This, of course, does not define space, but we learn that we can measure something even though we don't understand it perfectly. We will find that this is also true of time and matter. It's hard to define matter and time but it is easy to measure time intervals and weigh things.

Suppose you hold your hand open in front of you; there is space in front of your hand and space behind it. Now suppose you clench your fist. Your hand now occupies some of the space that was in front of it before. What happened to that space? Did you push it away? Is it still there? Can the hand and the space be there together? Of course, you know that there are some empty spaces within your clenched fist, but how about within the fingers and the bones? Is there space there?

Obviously this raises questions about the possible empty space inside matter. Is matter really solid all the way through or are there empty spaces within it? The modern theory is that matter is ultimately made up of tiny invisible particles called molecules and atoms. We will talk about this theory later in the series of films. The modern idea is that even things like iron and gold which appear completely solid to the eye are actually composed of little building blocks surrounded by a great deal of empty space.

Empty space! What does *that* mean? If space were really completely empty, its exploration would be rather pointless and dreary. A trip across the ocean is interesting because you eventually land on another continent. A trip through astronomical space will be interesting if you can land on the moon or on a distant planet. In other words, you can't get away from the fact that space exploration is going to involve not only space but matter and time as well.

Actually, as you travel away from the earth — let's say to the moon — the number of obstacles you meet (in the form of molecules) diminishes greatly. So much so that you might say that the space between the earth and the moon is a pretty good example of a vacuum. Still, it turns out that there are many millions of molecules and atoms in the "empty" space between the earth and the moon. Besides this material, the light and heat and radio waves that reach us from the sun and the other stars pass through space to get to us. Space is full of things like light and heat and radio waves, and these are measurable things which can make space exploration interesting even without landing on the moon or on another planet. This film is an introduction to space and to some of the interesting things that happen in the regions of space, both large and small.

Demonstration To Be Presented Before Showing the Film

A tin can is packed full of dirt. Ask the class if the tin can is full. If they say that it is, suggest that you could pour some water into it without making it overflow. Do it. There must have been space in the can. Now dump out the dirt and water into a wastebasket. Clean the inside of the can. Now ask the class if the can is empty. If they answer yes, suggest that the can is not empty, it is full of air. Is there really such a thing as completely empty space?

Experiments and Projects

1. It is important to become acquainted with the common units of measurement of length—such as the inch, the foot, the yard and the mile. It is also important to introduce the metric system early. The metric system is used in all scientific work in all countries of the world. Therefore, the student should get some idea of the relative size of a centimeter, a meter and a kilometer. Emphasis should be placed on the fact that in the metric system powers of ten are involved. The number of centimeters in a meter is ten times ten. The number of meters in a kilometer is ten times ten times ten. (2.54 centimeters equals one inch.)

Still another important idea is that some useful measurements can be made roughly and quickly in crude ways. Have a student take ten equal paces and measure this distance with a ruler. Divide by ten to make an estimate of the average pace. Find the length and width of a room by pacing.

Stretch your hand. How far is the distance from the tip of the thumb to the tip of the little finger? Find the average length of the span. Measure a table, using your stretched hand.

2. Given that light travels 186,000 miles in one second, how far will it travel in one minute, in one hour, in one day, in one year? In other words, how many miles is a light year? Multiply out to find the answer. This becomes a rather tedious project in longhand multiplication, but perhaps this problem can be used to introduce the powers of ten to the classroom.

First, show that multiplying by ten simply requires moving the decimal point to the right one place; multiplying by a hundred, moving the decimal point two places; multiplying by a thousand, three places, and so on.

Next, show that 10 X 10 can be written 10^{2}. 10 X 10 X 10 can be written 10^{3}. 10 X 10 X 10 X 10 is the same as 10^{4}, etc. The little number (called the exponent) simply indicates the number of tens that are multiplied together.

10^{6} equals 1,000,000 (one million). 10^{9} equals 1,000,000,000 (one billion). 10^{12} equals 1,000,000,000,000 (one trillion). Notice that the exponent also indicates how many zeros there are following the one. This is obviously an easy way to write big numbers.

10^{2} times 10^{3} equals 10^{5}. This can be proven by writing 10 X 10 (or 10^{2}) times 10 X 10 X 10 (or 10^{3}) equals 10 X 10 X 10 X 10 X 10 (or 10^{5}). In other words, to multiply, you simply add exponents. We can use this method of writing and multiplying numbers to find out how many miles light travels in a year.

Light travels 186,000 miles a second. We can write that 1.86 X 10^{5}.

There are 31,536,000 seconds in one year. That can be written 3.15 X 10^{7}.

Therefore, in a year, light travels:

1.86 X 10^{5} X 3.15 X 10^{7}

or:

1.86 X 3.15 X 10^{5} X 10^{7}

or:

5.86 X 10^{12}. This way of writing numbers is commonly used in science. It stands for:

5,860,000,000,000.

3. Another kind of project that can be motivated by this film is a study of the

solar system. Students can build a model which shows the relative sizes of the earth and the moon, and the distance between their centers. Use an orange to represent the earth and make a clay model of the moon to the proper scale. Then place the "moon" at the proper distance from the "earth."

What if you started your model with something like a basketball to represent the sun? Ask the question: is it possible to represent the earth to that scale? That is, could we make a clay model of the earth to the proper scale and place it at the proper relative distance from the basketball model of the sun?

The other scale factor to consider is time. If one student holds a large ball representing the earth and makes it rotate on its axis once to represent a day, what would the moon do in the meantime? What does the moon do while the earth rotates 28 times, for example? How would the earth move in relation to the sun during the same period of time?

4. Does light travel through a vacuum? Look at a burning flashlight bulb. Does the light pass through a vacuum to get to your eyes? Is there a vacuum inside the light bulb? Turn the flashlight off. Make a small hole in the glass of the bulb, being careful not to damage the filament. Now turn the bulb on. It will flash for a moment and then burn out. Why? Is it because there is no longer a vacuum inside the bulb and air around the filament makes it burn up quickly when it is lit?

5. Is there a vacuum between the sun and the earth? Will light travel through a vacuum? Get a little pinwheel radiometer in a local toy or drug store. The little pinwheel in this toy will turn when light energy hits it. The light can come from an ordinary electric light bulb, but when the toy is placed in the light of the sun it also spins. From where did the power come to make the pinwheel spin? If it came from the sun, how far did it travel?

Now ask the question, is the space between the sun and the earth really empty if it is full of light?

6. If you look at a ruler through a low-powered microscope, you can get a rough idea of how much space is covered by the entire field of the microscope as you look into it. Using the microscope as a measuring device, make some estimates on the thickness of thin objects like strings and human hairs.

If you look very closely at certain "solid" objects, can you see space in them? Try looking at a fragment of rock through your microscope. Are there some objects that actually have space in them, but in which the space is too small to be seen? How about water and alcohol?

Correlated References for Students and Teachers

TEXT REFERENCES FOR STUDENTS

Barnard, Stendler and Spock
Macmillan Science/Life Series, Book VI
The Macmillan Co., 1960
Unit 8, pp. 203-238

Beauchamp, Mayfield and West
Science Problems—1, Grade 7
Scott, Foresman and Co., 1957
Unit 1, pp. 4-23
Unit 3, pp. 82-83

Beauchamp, Mayfield and West
Science Problems—3, Grade 9
Scott, Foresman and Co., 1957
Unit 6, pp. 300-305

Beauchamp, Mayfield and West
Everyday Problems in Science, Grade 9
Scott, Foresman and Co., 1957
Unit 19, pp. 479-480

Craig, Roche and Navarra
Science Today and Tomorrow Series, Book VI
Ginn and Co., 1958
pp. 98-117

Frasier, MacCracken and Decker
Our Scientific World, Grade 8
L. W. Singer Co., Inc., 1956
Unit 1, pp. 2-33

Frasier, MacCracken and Decker
Singer Science Series, Book V
L. W. Singer Co., Inc., 1959
pp. 7-40

Jacobson and Lauby
ABC Science Series, Book IV
American Book Co., 1961
pp. 1-38

Schneider, Herman and Nina
Heath Elementary Science Series, Book IV
D. C. Heath and Co., 1956
pp. 287-302

SUPPLEMENTARY READING FOR STUDENTS

Born, Max
The Restless Universe
Dover, 1951

Schneider, Herman and Nina
How Big Is Big?
William R. Scott, Inc., 1950

REFERENCES FOR TEACHERS

Brinckerhoff, Cross, Watson and Brandwein
The Physical World
Harcourt, Brace and Co., 1958
Chapter 1, pp. 2-22
Chapter 4, pp. 52-59

Dull, Metcalfe and Williams
Modern Physics
Henry Holt and Co., 1960
Unit 1, chapter 2, p. 26

Mallinson, Mallinson and Welch
General Physical Science
McGraw-Hill and Co., 1961
Unit 2, chapter 3, pp. 37-54

Physical Science Study Committee
Physics
D. C. Heath and Co., 1960
Chapter 3, pp. 22-38

IV. The Universe

E. Stars and galaxies

Name and Description of Film	Other Grade Placements	Remarks
1. Constellations, Guides to the Night Sky ** Ind. Univ., 1961; 11 min; color This film offers the student the necessary information to locate the major constellations and to use these to locate other constellations. Examples of galaxies, nebulae and other celestial objects are provided by animation and photographs taken at the Mount Wilson and Mount Palomar observatories.	Gr. 8 - **	
2. Exploring the Night Sky * Ebf, 1956; 10 min., black & white Describes constellations and how they got their names, nebulae and other star phenomena, the setting and rising of stars, and how the stars affected the making of the calendar. Includes animation and special cinema techniques.	Gr. 8 - *	
3. The Stars ** 12 min., color, $120, International Film Bureau Inc. This film deals with stars and star groups. It deals with the sun. Attention is given to the characteristics of the sun as shown through photographs. The corona, prominences, and sunspots are given a great deal of attention. Attention is also given to galaxies and nebulae. The film ends with discussion of radio telescopes and the Jodrell Bank Experimental Station in England. For middle grades.		

* Good
** Excellent

The Universe - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. Stars and Star Systems * EBF, 1960; 16 min., black & white Shows an astronomer at work, explaining that with the use of powerful telescopes astronomers have been able to photograph about one and one-half billion stars; describes a radio telescope and balloon as other methods of astronomical observation. Discusses the vastness of the universe and the heavenly bodies of which it is comprised.	Gr. 8 - **	
5. Universe ** Nat'l Film Board, 1960; 30 min., b&w Simple presentation of structure of universe. Impression of immensity in time, space, number variety conveyed by discussion buttressed by astronomical photographs. Describes members of solar system and its position in Milky Way. Pictures work of an astronomer.	Gr. 8 - **	

* Good
** Excellent

II. Living Things

A. Life and life processes

Name and Description of Film	Other Grade Placements	Remarks
1. Amphibians: Frogs, Toads, and Salamanders ** Film Assoc., 1965; 11 min. Presents the four major groups of amphibia; frogs, toads, tree frogs, and salamanders. Differentiates between the tailed and tailless amphibia, illustrating their development from eggs and their ways of life.	Gr. 7 - ** Gr. 10 - * Gr. 5 -	Also listed II-B
2. Animals--Ways They Eat ** EBF, 1956; 11 min. Shows in detail how the body parts of various animals are related to their eating habits. Includes such examples as the cirri of barnacles, the mouth parts and legs of crayfish, the teeth of lions and cows, the tongues of butterflies, the noses of hogs, the beaks of birds, and the paws of squirrels.	Gr. 7 - **	
3. Ants ** EBF, 1948; 11 min ., black & white Depicts, by means of close-up photography, varied activities of four different types of ants--mound builders, black ants, household ants, and carpenter ants. Shows in detail the life cycle of the carpenter ant. Portrays an intercolony battle between mound builder and wood ants.	Gr. 7 - *	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. Aphids (Plant Lice) ** EBF, 1933; 12 min., black & white Reveals characteristics and the life cycle of the plant louse. Explains how in early spring, aphid eggs hatch into wingless females which, throughout the same season, give birth to new young every ninety minutes. Through cinemicrography portrays egg-laying, feeding, and wing development. Depicts how other insects destroy aphids, thus aiding in their control.	Gr. 7 - *	
5. Aquarium Wonderland ** Pat Dowling, 1960; 10 min., color In microscopic and unusual close-up scenes and animation, one sees how fish breathe, hear, feel, smell and swim. A boy shows how to set up and maintain an aquarium, using the proper amount of water, plants and food for the goldfish and other animal life it contains.	Gr. 1 - ** Gr. 3 - ** Gr. 4 - **	
6. Beaver Valley ** Walt Disney, 1953; 32 min., color Pictures the life of a beaver through the cycle of the seasons, showing how he meets his daily needs, builds his house, and conducts his courtship. Filmed around a beaver pond in the West. The other animal, bird and fish life of the area is also portrayed.	Gr. 4 - ** Gr. 7 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
7. Birds of North America, No. 4 * EBF, 1949; 11 min., color Depicts the identifying characteristics of three North American birds: the spotted sandpiper, the sora rail, and Barrow's goldeneye. Indicates their summer and winter ranges, and portrays, by means of close-up photography, the mother birds on their eggs, the eggs hatching, and the young birds venturing out into their world of rock, reed, and water.	Gr. 7 - **	Also listed II-B
8. Birds of the Seashore * EBF, 1951; 11 min., color Portrays the activities, habitats, and distinguishing marks of various North American water birds. Depicts gulls in flight and nesting in colonies; gannet colonies on Bona venture Island; elder ducks in the St. Lawrence estuary; and the black guillemot, blue heron, razor-billed auk, and cormorant. Includes bird calls.	K - ** Gr. 3 - ** Gr. 7 - * Gr. 5 - *	Also listed II-B
9. The Big Green Caterpillar ** Stanton Films, 1961; 11 min., color On an ordinary street there is a tree. On the tree there is a tiny insect egg. A boy finds the egg and raises the caterpillar that hatches out of the egg into an adult insect. The boy wonders how his pet grew so big in such a short time, eating only tree leaves. He wonders if chemicals in its body changed tree leaves into good food.	Gr. 1 - ** Gr. 2 - ** Gr. 7 - *	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
10. The Bobolink and Blue Jay ** Coronet, 1946; 11 min., color Shows the family life of the blue jay who lavishes attention on his helpless young, and the bobolink, who also is on the job when the youngsters get hungry.	Gr. 2 - ** Gr. 7 - **	Mature
11. Cecropia Moth ** Murl Deusing, 1960; 11 min., color Here is the life story of one of our most familiar insects. The story begins in late winter with the moth still in the cocoon. Shows the moth emerging from the cocoon in time-lapse photography. The film shows the complete life-cycle and the various changes that take place from the time the eggs are laid until the pupa is snug in a cocoon for the winter.	Gr. 7 - **	
12. The Cell-Structural Unit of Life ** Coronet, 1949; 11 min. Shows the basic relationship of our living bodies to other living organisms in the world. Presents, through photomicrography, the living protoplasm in a leaf cell, and the amoeba taking food, growing and dividing. Explores also the functional differences in cell structure.	Gr. 7 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
13. Characteristics of Plants and Animals ** Ind. Univ., 1954; 10 min., color Surveys living organisms with emphasis on three concepts; that all life comes from pre-existing life; that plants and animals, microcopic and macroscopic, in all classifications have common basic characteristics; and that the cell is the structural unit of life at all levels.	Gr. 7 - ** Gr. 10 - **	
14. The Colour of Life * Nat'l Film Board, 1955; 24 min. Discusses the growth of a seedling, the seasonal upsurge of life in a giant forest tree, and the mysterious alchemy of a single leaf. Presents, in magnified dimension, the maple leaf and segments of the tree to illustrate the physiological processes that go on in all plants. Through detailed time-lapse photography and animated diagrams, reveals the silent, methodical way in which nature makes the woodlands tree in springtime and bright colored in autumn.	Gr. 7 - ** Gr. 10 - **	A little difficult
15. Earthworms ** Pat Dowling, 1957; 11 min., color Shows how the earthworm, after emergence from the cocoon, eats its way through earth, digests food, and brings castings to the surface. Explains how the earthworm forms tunnels that help to aerate and enrich the soil and carry water to plant roots.	Gr. 3 - ** Gr. 4 - ** Gr. 7 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
16. Flowers at Work ** EBF, 1931; 11 min., black & white Explains the main function of flowers as that of producing seeds. Animated drawings describe the structures and functions of the sepal, petal, stamen, pistil, pollen, style, and ovary. Close-up and slow-motion photography depict different methods of pollination of various types of flowers and reveal the work of the bee in cross-pollination.	Gr. 7 - * Gr. 10 - *	Adv. vocabulary
17. Frog * EBF, 1931; 10 min., black & white Traces the development of the frog and examines its physical traits and characteristics. Through close-up and time-lapse photography portrays the development of the tadpole embryo and the hatching of egg. Depicts the growth of the tadpole and discloses the physical characteristics and natural traits of the adult frog.	Gr. 7 - ** Gr. 10 - **	
18. Gray Squirrel ** EBF, 1961; 10 min., black & white Presents the story of three young squirrels and their mother. Follows the growth and daily activities of the young squirrels from spring to midwinter. Shows the mother feeding and caring for her young, and the young squirrels learning to climb, to hunt for food, and to take care of themselves.	Gr. 2 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
19. The Growth of Flowers * Coronet, 1945; 11 min., color Time-lapse photography shows the miracle of growth. Presents the rose, orchid, jack-in-the-pulpit, daffodil, and iris sprouting from the ground, growing, bursting into bloom, and dying.	Gr. 7 - * Gr. 10 - **	
20. Growth of Seeds ** EBF, 1957; 14 min., color Combines graphic closeups with animated drawings and time-lapse photography to show sources from which plant seeds are obtained; describes the structure of seeds; and shows processes of germination and plant growth. Illustrates differences between flowering plants and seed plants.	Gr. 7 - ** Gr. 10 - **	Adv. vocabulary
21. Hemo, the Magnificent ** AT & T, 1957; 59 min., color Produced by Frank Capra Productions. Tells the story of the blood, the heart and circulation. Shows scenes of the human heart and capillaries in action. Includes animation.	Gr. 7 - ** Gr. 10 - *	
22. The Honeymakers ** U of M, 1952; 20 min., color Studies details of the honeybee's life cycle, from the laying of the eggs by the queen until the adult worker, drone, or queen emerges. Depicts the activities of the hives from the gathering of nectar to swarming.	Gr. 7 - ** Gr. 10 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
23. House-fly ** EBF, 1936; 11 min., color Describes the house-fly as a menace to health through a portrayal of its habits and life history. Traces physical development from egg-laying through larval and pupal stages to the emergence of the young fly. Through magnified views, reveals biological structure and methods of carrying and spreading disease germs. Suggests control methods.	Gr. 7 - ** Gr. 10 - **	
24. How Plants Reproduce ** McGraw-Hill, 10 min., color, A simple explanation of how plants reproduce: the function and parts of the flower, the fruit and the seed.	Gr. 3 - **	
25. How Seeds Are Scattered ** McGraw-Hill, 10 min., color, Discusses and illustrates the many different ways in which seeds are dispersed, by wind, water and animals.	Gr. 3 - **	
26. The Human Body: Respiratory System ** Coronet, 1961; 14 min., color Locates and describes the organs of the respiratory system, and shows in animation and live demonstration the mechnics of ventilation and the physics of diffusion between aveoli and capillaries. Illustrates the effect on the respiratory system of varying needs for oxygen, and the function of the respiratory system in providing needed oxygen and eliminating carbon dioxide.	Gr. 7 - ** Gr. 10 - **	Also listed II-D

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
27. Insect Food ** Pat Dowling, 1958; 14 min., color Close-up photography illustrates the variety of foods consumed by different insects. Damage done by insects to trees, grain, plants, furniture, clothes, and rugs is shown. Insects that eat other insects are shown at work--praying mantis, ant lion, etc.	Gr. 4 - ** Gr. 7 - ** Gr. 10 - **	
28. Introducing Insects: Butterflies, Beetles, Bugs ** EBF, 1961; 17 min., color Within the animal kingdom is the fascinating world of insects. This film explains how insects are classified in the animal kingdom--how they differ from other animals and how the main order of insects differ from each other. Magnified close-ups, slow motion and time-lapse photography reveal the structure and characteristics of insects and show different stages in their life cycles.	Gr. 7 - ** Gr. 10 - **	
29. Learning About Flowers ** EBF, 1958; 10 min., color Portrays in vivid photography the story that there are many different kinds of flowering plants. Time-lapse photography is extensively used to show the opening of some of the more common flowers of our fields and gardens. The film is designed to help the student appreciate the beauty in flowers and to realize that the purpose of the flower is to produce seeds.	K - * Gr. 1 - ** Gr. 3 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
30. Learning About Leaves ** EBF, 1958; 11 min. With time-lapse photography, animation, and close-ups, explains how leaves are important to plants, animals, and man; compares different kinds of leaves; shows how leaves are related to other parts of a plant; and illustrates the functions of green leaves, and the changes that take place during the different seasons.	Gr. 2 - **	
31. Learning About Seeds ** EBF, 1961; 11 min., color Explains that there are many different kinds of seed-bearing plants and that seeds have many sizes, shapes, and colors. Through time-lapse photography we see how seeds grow and what they need for growth. Several methods of seed dispersal are also clearly illustrated.	K - ** Gr. 1 - ** Gr. 3 - **	
32. Life in a Pond ** Coronet, 1950; 11 min., color Discloses pond life in action providing examples of important principles of natural science. Shows in microscopic and underwater scenes the variety of self-sustaining plants and animals found in a typical fresh water pond, among them the shoreward, floating and submerged green plants and water fleas, beetles, insect larvae, dragonfly nymphs, and minnows.	Gr. 4 - ** Gr. 7 - ** Gr. 10 - *	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
33. Life of a Plant ** EBF, 1950; 11 min., color Through time-lapse photography shows steps in the life cycle of a typical flowering plant, the pea. Identifies the roles of roots, stems, leaves, flower, fruit, and seed. Animated drawings reveal the functioning of the various parts of the plant.	Gr. 7 - **	
34. Little Animals * Pat Dowling, 1959; 11 min., color A variety of small animals beginning with a kitten and carrying through to microscopic animals demonstrates three characteristics of life: movement, feeling, and eating. The relationship and similarities of the various types of animals in life pattern is brought out. A young boy and girl set the scene for discovering these animals.	Gr. 3 - ** Gr. 4 - *	Easy film
35. Living and Non-living Things ** United World, 1949; 12 min., black & white Children observe living chickens and plants and such non-living objects as a kite moving in the wind, a locomotive burning coal for energy, and crystals growing and moving. Explains the important differences between living and non-living things in terms of the characteristics of growth, development, reproduction, and sensitivity.		

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
36. Living Bird ** Murl Deusing, 1960; 13 min., color Shows a variety of characteristics and behavior of birds. Presents their powers of flight and uses animation to compare birds' metabolism with that of man. Examines their senses of sight, smell, hearing, and their adaptations of bills to the types of food they eat. Illustrates courtship of birds by picturing the drumming of ruffed grouse, and the dance of prairie chickens. Pictures nest building, incubation, and the role of the egg tooth in hatching. Concludes by presenting the parasitic nesting habits of cowbird.	Gr. 7 - ** Gr. 10 - **	
37. Marine Life ** EBF, 1953; 11 min., color Underwater photography is used in showing how big fish hunt for victims while the small fish seek safety. Includes scenes of a porpoise, a sea turtle, an angel fish, a Spanish hogfish, a sawfish, an octopus, a green moray, a baracuda, and different species of crabs and sharks. Photographed at the Marine Studios at Marineland, Florida.	Gr. 7 - ** Gr. 10 - **	
38. Monarch Butterfly Story ** EBF, 1951; 11 min., black & white Portrays in detail the life cycle, minute features, and unique activities of the monarch butterfly in its four stages of development. Close-up photography depicts the monarch laying its eggs, and the caterpillar eating its way out of the egg, feeding, molting, forming its chrysalis, and emerging as a butterfly.	Gr. 7 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
39. The Mosquito ** EBF, 1947; 10 min., black & white Describes the life cycle of the mosquito, and emphasizes the importance of malaria mosquito control. Through close-up photography, portrays egg-laying, egg-hatching, the molting process, the pupa stage, and the emergence of the adult mosquito. Presents examples of areas where mosquitoes breed, and demonstrates methods for combating the insect.	Gr. 10 - *	
40. Orange Grower ** EBF, 1939; 11 min., black & white Depicts the phases of orange growing from planting to shipping, and emphasizes the work and care required to produce quality fruit. Portrays a typical orange grower and his family at work. Shows budding, pruning, planting, fertilizing, irrigating, and the controlling of insects and frost. Gives illustrations of the machinery and scientific methods used in readying oranges for distribution to all parts of the country.		—
41. A Parasitic Plant ** EBF, 1931; 10 min., black & white Describes the characteristics and life cycle of a typical parasitic plant, the dodder. Close-up and time-lapse photography reveal the flower with its ovary and seeds, and the movements of the dodder as it grows, gropes about, attacks, and entwine other plants cinemicrography demonstrates structure of the suckers, and animated drawings portray their parasitic action on a flax stalk.	Gr. 7 - * Gr. 10 - *	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
42. Planting Our Garden *	Gr. 4 - **	
43. Plants Make Food *	Gr. 4 - **	
44. Poultry on the Farm **	K - ** Gr. 2 - **	
45. Respiration *	Gr. 7 - ** Gr. 10 - *	

42. Planting Our Garden *

EBF, 1952; 11 min., color

Follows a family's work on their garden from the early indoor planting of such vegetables as tomatoes, cabbages, and broccoli, through the preparation of the garden plot, to the final transplanting of seedlings, the planting of potatoes, and the sowing of seeds of other vegetables. Shows how the children learn the requirements of healthy plant growth.

43. Plants Make Food *

Churchill-Wexler, 1959; 11 min., color

Two children learn something of the process by which plants make food (photosynthesis): the functioning of roots, stems and leaves; the transforming of water, minerals and carbon dioxide into foods; the role of chlorphyll and sunlight.

44. Poultry on the Farm **

EBF, 1960; 11 min., color

Explains how different kinds of poultry live on a typical small farm. Shows chickens, geese, ducks and turkeys at different ages in their natural environment. Follows the development of a chick embryo and the hatching of a chick. Includes review questions.

45. Respiration *

United, 1951; 14 min., black & white

Describes internal and external respiration, showing distribution of oxygen by means of the circulatory system and release of energy within a muscle cell by means of oxidation of food substances.

* Good
** Excellent

Living Things - A, (continued)

Name and Description of Film	Other Grade Placements	Remarks
46. The Salmon Story ** EBF, 1950; 11 min., color Portrays basic stages in the life cycle of the salmon, and calls attention to the steps taken by modern fish hatcheries to insure a continuing supply of this food fish. The purse seine method of catching salmon is featured as one commonly in use today. Follows the catch from the sea to the cannery, depicts canning operations including cleaning, scaling, removing of heads, canning, cooking, and final preparation for shipment.	Gr. 7 - *	
47. Seal Island ** Walt Disney, 1948; 18 min., color A study of the fur-bearing Alaskan seals during the mating season when the seals return to the barren place of their own birth to breed. The bulls arrive early in May, select sites for their summer homes where they await the arrival of the females. The young males spar like prizefighters, training to challenge a beachmaster and take possession of his harem. Near tragedy develops when a baby seal loses his mother, but she finds him among the island's more than 100,000 inhabitants despite his apparent resemblance to all the other pups. Filmed on one of the Pribilof Islands in the Bering Sea.	Gr. 4 - **	Advanced thriller

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
48. Seed Dispersal ** EBF, 1931; 11 min., black & white Considers various means by which seeds are disseminated; how they anchor themselves to the ground to facilitate germination; and how they protect themselves. Demonstrates the dispersal of seed plants by wind, transportation by animals, and propulsion from seed cases. Describes anchoring methods by clamping, hooking, adhesion, and corkscrew motion. Portrays various natural devices for protection while sprouting.	Gr. 4 - ** Gr. 7 - ** Gr. 10 - *	
49. Snapping Turtle ** EBF, 1940; 11 min., black & white Presents the life cycle of the snapping turtle--birth, growth, and the struggle for existence and survival. Shows its activities, its encounters with other animal life, how it gets its food and lays its eggs, how its young hatch and develop, and how it hibernates.	Gr. 7 - * Gr. 10 - *	Easy film
50. Spiders * EBF, 1931; 11 min., color Traces the life cycle of the nursery-web spider and illustrates characteristics of the orb-web, funnel-web, and trap-door species. Close-up photography reveals the female as she lays her eggs and encloses them in a silken cocoon to await hatching. Other sequences depict the hatching of eggs, development of the young, web-spinning, and ensnaring of insects for food.	Gr. 7 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
51. Spring Blossoms * Int'l Film Bur., 1954; 20 min., color Time-lapse photography pictures spring flowers opening and growing. Among them are the azalea, camellia, hepatica, trillium, fern, May apple, foxglove and buttercup.	Gr. 5 - Gr. 3 - ** Gr. 7 - *	Also listed II-B
52. The Story of the Bees ** United World, 1949; 20 min., black & white Microphotography is used in showing the life cycle of the honey bee and details of the community life within the hive. Includes sequences showing the role of the queen in the hive.	Gr. 7 - ** Gr. 10 - **	
53. Sunfish ** EBF, 1941; 11 min., black & white Portrays the life cycle of the sunfish, its activities, and its relations to its physical and biological environment. Through submarine photography, shows the male constructing the nest, the female laying the eggs, and the process of fertilization. Depicts the male guarding the nest until the eggs hatch and then protecting the young fish against predatory hazards.		
54. Taking Care of Our Garden * EBF, 1952; 10 min., color Two children working with their father in the garden discover the positive and negative factors in plant growth. Includes scenes of weeding, thinning, detecting and fighting insects, watering, and hoeing.	Gr. 7 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
55. Trees: Our Plant Giants ** Academy Films, 1960; 14 min. Uses animated diagrams to show how a tree grows and to show the various layers in a cross-section of a tree. Pictures the many uses of trees in industry. Illustrates use of trees as soil conservers, and as homes for birds.	Gr. 4 - **	
56. Water Birds EBF, 1945; 10 min., black & white Studies of the egret, mallard duck, Canada goose, and brown pelican. Examines briefly the features, activities, and habitats of the flamingo and lesser scaup. Emphasizes distinctive characteristics of each bird, its habits, environment, adaptiveness, and care of young. Animated maps trace the migration of the Canada goose, and close-up photography reveals the hatching and development of young pelicans.	Gr. 5 - Gr. 7 - Gr. 10 -	No eval. yet No eval. yet No eval. yet
57. Water Birds ** Walt Disney, 1957; 32 min., color A picture of rare beauty, alive with excitement and rare glimpses into the behavior of seaside and marshland feathered creatures--climaxed by a striking musical bird ballet of the air.	Gr. 5 - Gr. 4 - ** Gr. 7 - ** Gr. 10 - **	Also listed II-B

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
58. Waterfowl in Action * U of M, 1950; 10 min., color Shows migrating water fowl as they stop to feed and rest in the marshes near Wheaton, Minn. Pictures the Franklin gull, gadwall, spoon bill, green- and blue-winged teal, diving ducks, blue and lesser snow geese, whistling swans, and others on the water and in flight. Explains feeding habits and identifying field marks.	Gr. 7 - ** Gr. 10 - * Gr. 5 -	Also listed II-B
59. What's Alive ** Film Assoc. of Calif., 1962; 10 min., color Helps the student toward an understanding of the activities that distinguish living from non-living things. Defines living things in terms of a set of activities. This print shows that only a thing that can move, respond, change fuel into energy, reproduce and grow can be said to be "alive".	Gr. 3 - ** Gr. 4 - ** Gr. 7 - **	
60. Wonders of Plant Growth ** Churchill-Wexler, 1960; 10 min., color A girl and boy experiment with plants. They grow plants from a bean and a squash seed, the stem of a geranium, the leaf of a succulent, and the root of a sweet potato plant. Growth is shown in time-lapse photography. Other experiments with plants which children can perform are indicated.	Gr. 2 - ** Gr. 3 - **	

* Good
** Excellent

Living Things - A. (continued)

Name and Description of Film	Other Grade Placements	Remarks
61. Wood Duck Ways ** U of M, 1956; 20 min., color Follows the wood duck from the courting and mating season in the early spring, through the incubation and hatching periods and the brood's emergence from its tree home. Shows three broods actually leaving their nests and landing on the ground. Depicts the brood as it feeds and grows to maturity, and makes suggestions on how to construct and place nesting houses.	Gr. 2 - * Gr. 7 - **	Diff. vocabulary
62. You - The Living Machine ** Walt Disney, 1959; 8 min., color Shows the difference between a living machine and a manufactured machine and how to take care of our living machines.	Gr. 3 - **	

* Good
** Excellent

II. Living Things

B. Classification

Name and Description of Film	Other Grade Placements	Remarks
1. Amphibians: Frogs, Toads, and Salamanders Film Assoc. of Calif., 1956; 11 min. Presents the four major groups of amphibia: frogs, toads, tree frogs, and salamanders. Differentiates between the tailed and tailless amphibia, illustrating their development from eggs and their ways of life.	** Gr. 5 - Gr. 7 - ** Gr. 10 - *	Also listed II-A
2. Animals of Alaska ** Northern Films, 1958; 11 min., color Shows views of typical wild animals of Alaska, including the Dall sheep, mountain goat, bear, moose, pika, ground squirrel, hoary marmot, porcupine, red fox, seal, sea lion, walrus, caribou, bison, and musk ox. Includes maps showing the habitat of each.	K - ** Gr. 4 - *	
3. Animals Unlimited ** Assoc. Films, 1950; 19 min. A field trip across Africa brings to this picture painstaking photography of Africa's native animals in their native environments. While the vehicles traveled the work roads, numerous side trips into the bush and forests enabled the photographers to find the animals in their natural haunts. Much of the game is shown both pursuing and being pursued by their natural enemies.	Gr. 7 - ** Gr. 10 - *	

* Good
** Excellent

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. The Bear and Its Relatives ** Coronet, 1943; 16 min., black & white Presents scientific and zoological facts about the racoon, panda, kodiak or Alaskan brown bear, polar bear, grisly bear, and the American black bear.		
5. Bear Country ** Walt Disney, 1958; 33 min., color No animal has excited more human curiosity, laughter and respect than the North American black bear. Disney cameras present a remarkable photographic coverage of this giant of the Rocky Mountain region.	Gr. 7 - **	
6. Bird in Your Backyard ** 11 min., sd., color, 16 mm. Two brothers share the fun and responsibility of a project to attract birds to their backyard. They make a feeding tray and observe the birds that come to feed; clean and refill a bird bath and learn the drinking and bathing habits of the bird visitors; discover a towhee nest, watch the eggs hatch, observe the parent birds care for their babies, and later see the young birds leave the nest.	Gr. 2 - ** Gr. 3 - ** Gr. 7 - ** Gr. 4 - **	

* Good
** Excellent

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
7. Birds Are Interesting ** EBF, 1950; 10 min. Presents some basic biological concepts concerning birds. Provides a systematic analysis of birds by classifying them under three categories--swimming and wading birds, birds of prey, and perching birds. Contrasts such features as bills, feet and wings to characterize each type. Birds depicted include hawks, owls, ducks, pelicans, canaries and domestic chickens.	Gr. 4 - ** Gr. 7 - **	
8. Birds: How We Identify Them ** Coronet, 1960; 11 min., color Follows two boys, who with field glasses and bird guide book, set out to look for birds. Shows how to distinguish one bird from another; by appearance; by the sounds they make; and by their actions, both on the ground and in the air. Points out the identifying characteristics of many of the more common birds, showing them in their natural habitat.	K - ** Gr. 2 - **	
9. Birds of North America, No. 4 * EBF, 1949; 11 min,, color Depicts the identifying characteristics of three North American birds: The spotted sandpiper, the sora rail, and Barrow's goldeneye. Indicates their summer and winter ranges, and portrays, by means of close-up photography, the mother birds on their eggs, the eggs hatching, and the young birds venturing out into their world of rock, reed and water.	Gr. 5 - Gr. 7 - **	Also listed II-A

* Good
** Excellent

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
10. Birds of the Dooryard ** Coronet, 1954; 11 min. Presents birds which build their nests in gardens and near homes--robins, yellow warblers, eastern phoebes, yellow-shafter flickers, cardinals, swallows, house wrens, and purple martins. Describes the differences among these birds, their ways of protecting their nests and feeding their young, and ways in which they can be encouraged to nest around houses.	K - ** Gr. 2 - ** Gr. 3 - ** Gr. 7 - **	Adv. vocabulary
11. Birds of the Seashore * EBF, 1951; 11 min., color Portrays the activities, habitats and distinguishing marks of various North American water birds. Depicts gulls in flight and nesting in colonies; gannet colonies on Bonaventure Island; eider ducks in the St. Lawrence estuary; and the black guillemot, blue heron, razor-billed auk, and cormorant. Includes bird calls.	Gr. 5 - Gr. 3 - ** K - ** Gr. 7 - *	Also listed II-A
12. The Grasshopper: A Typical Insect ** Coronet, 1955; 6 min., color Presents various characteristics and habits of the grasshopper. Explains that it is an insect because its body is divided into three parts and it has three pairs of legs. Pictures its strong hind legs, spiracles, and its compound eyes. Describes its life cycle states as an example of incomplete metamorphosis. Mentions destructiveness of the insect.	Gr. 7 - **	

* Good
** Excellent

Living Things - B. (continued)

Name and Description of a Film	Other Grade Placements	Remarks
13. The Housefly and Its Control ** Coronet, 1962; 11 min., color Views a large-scale model and close-up photography of the egg-laying, hatching and emergence of the adult from the pupa; used to portray the anatomy, life-cycle and feeding habits of the common housefly. Shows how the housefly contaminates food and spreads diseases, and recommends methods for combating it.	Gr. 7 - ** Gr. 10 - **	
14. Insect Collecting ** Pat Dowling, 1960; 14 min., color Points out that collecting specimens is an important part of any study of insect life. Shows common and some uncommon terrestrial and aquatic insects in close detail and tells where to look and how to capture specimens. Describes methods of collecting which include netting, beating of house plants, night collecting, investigating dead parts of trees, using the Berlese funnel to procure microscopic specimens, and aquatic methods. Explains where to look for larvae, pupae and eggs, and how to raise them to adult stages.	Gr. 7 - ** Gr. 10 - **	
15. Insect Zoo ** EBF, 1950; 10 min., color Two children make an insect zoo in their yard and study the characteristics of the katydid, cricket, butterfly, milkweed bug, ladybird beetle, ant, and praying mantis. Shows by means of close-up photography the distinguishing features of each insect, and depicts simple homes which can be made for insects in an exhibit.	Gr. 3 - **	

* Good
** Excellent

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
16. Mammals Are Interesting ** EBF, 1953; 12 min., color Discusses the characteristics of protozoa, sea anemones, fish, reptiles, birds, and insects, and explains how they differ from mammals. Shows how hoofed mammals, carnivores, rodents, and primates are basically alike and describes the characteristics which are peculiar to each group.	Gr. 7 - ** Gr. 10 - *	
17. Putting Animals in Groups ** Int'l Film Bur., 1959; 13 min., color Introduces children to the idea that they can classify animals by observing animal structures. Explains distinctive characteristics of mammals, birds, reptiles, amphibians, fishes, and insects. Scientific vocabulary kept to minimum. Common animals used. Simple classifications. Frequent questions.	Gr. 7 - **	
18. Reptiles ** EBF, 1955; 15 min., color This film shows some of the most fascinating animals of the world. As an introduction, it brings to our attention the reptiles of prehistoric days. The film continues in discussing the five kinds of reptiles that inhabit the earth today. It points out many interesting facts about each of these kinds.	Gr. 7 - ** Gr. 10 - **	

* Good
** Excellent

3

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
19. Reptiles and Their Characteristics ** Coronet, 1959; 11 min. Identifies the five orders of animals that make up the reptile group and points out their common characteristics and some of their differences. Pictures snakes, lizards, turtles, crocodilians, and the rare tuatara in their native habitats; explains how they live and reproduce, their adaptations to their environment, and some of the ways in which they benefit mankind.	Gr. 4 - ** Gr. 7 - **	
20. Snakes ** Coronet, 1947; 11 min. A description of the kinds of snakes found in the United States. With emphasis on the appearance and habits of the four poisonous types; the rattlesnake, the copperhead, the cottonmouth moccasin, and the coral snake.	Gr. 7 - *	
21. Spring Blossoms * Int'l Film Bur., 1954; 20 min., color Time-lapse photography pictures spring flowers opening and growing. Among them are the azalea, camellia, hepatica, trillium, fern, May apple, foxglove, and buttercup.	Gr. 5 - Gr. 3 - ** Gr. 7 - *	Also listed II-A
22. Tide Pool Life ** Instruc. Films, 1947; 11 min. Studies some of the more usual species of marine life found near rocky shore and tide pools, including mussels, whelks, sea anemones, sea urchins, and abalones.	Gr. 7 - ** Gr. 10 - **	

* Good
** Excellent

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
23. Toads ** Pat Dowling, 1957; 10 min., color A description of the life and habits of the toad, an animal that lives partly in the water and partly on land, and is one of the oldest known amphibians. Hatched in shallow water, the animal develops lungs and legs before he can be a land animal. It eats all types of insects, catching them by its long sticky tongue. Toads are the natural prey of snakes.	Gr. 4 - ** Gr. 7 - **	Easy
24. Trees: How We Identify Them ** Coronet, 1958; 11 min. Points out ways to identify trees--by shape, bark, leaves and fruit--and explains the differences between deciduous trees and evergreens. Shows individual characteristics of many trees.	Gr. 7 - **	
25. Water Birds ** Walt Disney, 1957; 32 min., color A picture of rare beauty, alive with excitement and rare glimpses into the behavior of seaside and marshland featured creatures--climaxed by a striking musical bird ballet of the air.	Gr. 4 - ** Gr. 7 - ** Gr. 10 - ** Gr. 5 -	Also listed II-A

* Good
** Excellent

Living Things - B. (continued)

Name and Description of Film	Other Grade Placements	Remarks
26. Waterfowl in Action * U of M, 1950; 10 min., color Shows migrating water fowl as they stop to feed and rest in the marshes near Wheaton, Minn. Pictures the Franklin gull, gadwall, spoon bill, green- and blue-winged teal, diving ducks, blue and lesser snow geese, whistling swans, and others on the water and in flight. Explains feeding habits and identifying field marks.	Gr. 7 - ** Gr. 10 - * Gr. 5 -	 Also listed II-A
27. Yours For a Song ** Roy Wilcox, 1954; 22 min., black & white Shows a backyard bird sanctuary in Berlin Conn., which was established to attract migrating and resident birds throughout the year. Explains that birds are attracted to yards and gardens if they are provided with food, water and shelter. Includes views of 24 different species of birds.	K - ** Gr. 3 - **	

* Good
** Excellent

II. Living Things

E. Human body

Name and Description of Film	Other Grade Placements	Remarks
1. Care of the Hair and Nails ** EBF, 1951; 11 min., black & white A fairy tale character uses magic to help children learn good habits. She shows them how to clean and manicure fingernails, how to trim toenails, and how to shampoo and brush the hair. She lets them see some common diseases of the hair, and through animated drawings, shows the structure of hair and nails and explains why their care is important.	K - ** Gr. 1 - **	
2. Care of the Skin ** EBF, 1949; 11 min., black & white Demonstrates good habits of skin hygiene and illustrates common skin ailments. Portrays three children as they prepare for bed to show how to wash the hands and face and how to bathe. Through animated drawings describes the structure of the skin and explains why soap is necessary for cleanliness.	K - ** Gr. 1 - *	
3. Community Health and You ** McGraw-Hill, 1955; 19 min., black & white The local health department protects water and food supplies and insures proper disposal of garbage, sewage and insutrail wastes. Methods of purifying water, the functions of laboratory tests and vaccines in preventing the spread of communicable disease, and the cooperation of Red Cross, community hospitals and family physicians with the Health Department are discussed.	Gr. 7 - * Gr. 10 - *	A little diff. Easy film

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
4. Defense Against Invasion ** Walt Disney, 1946; 13 min., color Explains how vaccination makes the body immune to certain diseases. Animated cartoon.	Gr. 7 - *	
5. Dental Health: How and Why * Coronet, 1949; 11 min., black & white Reviews what research and experimentation have done to promote better dental health. Demonstrates new sodium fluoride applications and techniques of oral hygiene to show the relation of diet to the development and decay of teeth.	Gr. 5 -	Also listed Intro.
6. Exercise for Happy Living ** EBF, 1950; 11 min., black & white Dramatizes the role of exercise in building a strong body and a healthy, happy personality. Depicts a boy's keen disappointment at being only a substitute on the neighborhood ball team. Portrays his negative attitude toward exercise. Reveals, by means of a dream sequence in animation, the healthy effects of exercise upon muscles and thus stimulates in the boy an eagerness to acquire good health habits of exercise.	Gr. 3 - **	
7. Exploring Your Growth ** Churchill-Wexler, 1957; 11 min. Simple animation explains in detail how food is digested and assimilated. The digestive process in the mouth, stomach, and intestines is demonstrated. Microphotography is used to explain how the cells function and how food causes the cells to grow and divide.		

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
8. Growing Up (Preadolescence) ** Coronet, 1958; 11 min. Illustrates variations in the normal growth process, using animation and silhouette photography to show that growing up is an uneven process which differs in boys and girls, varying with individuals and age. Explains the role of the endocrine glands in controlling growth along with health measures which aid the normal growing process.		
9. Hear Better: Healthy Ears ** Coronet, 1950; 11 min. Explains the structure of the ear, the process of receiving air vibrations and transmitting them into sounds, and the care of the ears. Stresses the pleasure of hearing well.		
10. The Heart: How It Works ** McGraw-Hill, 1955; 11 min. Animated diagrams demonstrate the functioning of the auricles, ventricles, and valves of the heart, arteries, veins, the pulse, and how blood is pumped from the heart to all parts of the body and to the lungs. Methods of examining the heart are explained as are ways of keeping it strong and healthy.	Gr. 7 - **	

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
11. Heart, Lungs and Circulation ** Coronet, 1959; 11 min. Explains how the heart, lungs, veins, arteries and capillaries work together in the process of circulation. Uses animation, cinefluorography and a combination of artwork and a live subject to visualize the key functions. Suggests principles to help maintain healthy heart and lungs.	Gr. 7 - **	
12. How Our Bodies Fight Disease ** EBF, 1955; 8 min., black & white Shows the four ways in which the body defends itself against sickness through the nose, mouth and windpipe, the lymphatic system, the circulatory system, and by producing antibodies.	Gr. 10 - **	
13. The Human Body: Circulatory System ** Coronet, 1956; 14 min., color Animation, cinefluorography, drawings and close-ups of live organs are used in analyzing the entire circulatory system. Explains in detail the functions of the heart, lungs and kidneys; follows the flow of blood through all parts of the body; and explains the role of the circulatory system in maintaining good health.	Gr. 7 - ** Gr. 10 - **	

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
14. The Human Body: Respiratory System **	Gr. 7 - ** Gr. 10 - *	Also listed II-A
Coronet, 1961; 14 min., color		
Locates and describes the organs of the respiratory system, and shows in animation and live domonstration the mechanics of ventilation and the physics of diffusion between aveoli and capillaries. Illustrates the effect on the respiratory system of varying needs for oxygen, and the function of the respiratory system in providing needed oxygen and eliminating carbon dioxide.		
15. The Human Skeleton **	Gr. 7 - ** Gr. 10 - *	
United, 1951; 11 min., black & white		
Through the imposing of animated diagrams and X-ray photography a human model demonstrates the functions of the skeleton in the support, protection, and movement of the body. Shows details of the structure and movements of various types of joints.		
16. Learning About Your Nose **	Gr. 7 - **	
EBF, 1956; 9 min.		
Explains how the nose serves as a hallway between the changeable outside world and sensitive breathing organs. Shows its functions and suggests better health habits.		

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
17. Sleep for Health ** EBF, 1950; 11 min., black & white Presents the importance of regular sleeping habits from the viewpoint of a child. Shows the child how a regular bedtime which allows for sufficient sleep helps him attain goals which he himself desires. Emphasizes the child's own responsibility in the formation of good habits. Explains dreaming as a normal part of sleeping. Illustrates how lack of sleep causes irritability and interferes with the enjoyment of everyday living.	K - ** Gr. 1 - **	
18. Sniffles and Sneezes ** McGraw-Hill, 1961; 10 min., black & white Why colds start, how they spread and what to do to prevent them are shown in this film. By means of a unique device, the film effectively portrays the most common ways in which cold-producing viruses are spread. It also shows ways in which the body defends itself against germs.	Gr. 7 - **	
19. Teeth: Development and Care ** EBF, 1945; 11 min., black & white Explains development and structure of teeth and stresses importance of proper care. Reveals the growth cycle of teeth from embryonic stage through adulthood. Demonstrates the cause of decay and how it can be prevented by eating proper foods, brushing the teeth regularly and properly, and consulting a dentist frequently. Calls attention to organized community programs for dental care.		

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
20. Visual Perception * Educ. Test. Serv., 1959; 20 min., color Dr. Hadley Cantril discusses his investigations at the Perception Demonstration Center at Princeton University of the effects of some of our assumptions on what we see. Shows a distorted room that looks normal, with illustrations that include a rotating trapezoid that appears to oscillate, balloons that seem to move when in reality they are being inflated and deflated, or illuminated and darkened.	Gr. 7 - * Gr. 10 - **	Difficult
21. Work of the Blood ** EBF, 1957; 13 min. Reveals through laboratory analysis of a blood sample the structure of blood cells and the composition of plasma. Animated drawings and X-ray motion pictures of the circulatory system illustrate the work of the blood in circulating food elements and other materials to body cells, removing wastes, equalizing heat distribution, and providing defenses against disease. Demonstrates methods of typing blood and giving transfusions.	Gr. 7 - ** Gr. 10 - **	
22. You and Your Ears ** Walt Disney, 1957; 9 min., color Jiminy Cricket explains the structure of the ear and shows how sound waves affect the ear.		

* Good
** Excellent

Living Things - E. (continued)

Name and Description of Film	Other Grade Placements	Remarks
23. You and Your Eyes ** Walt Disney, 1956; 10 min., color Jiminy Cricket explains that though eyes always serve for protection, human eyes differ from those of other animals. Because our eyes are constructed with both rods and cones, we can read, distinguish color, and judge distances. Other animals, such as chickens, frogs and bees, cannot. Because eyes are so important, we must observe a few simple health rules to protect them.	Gr. 7 - **	
24. Your Health: Disease and Its Control ** Coronet, 1954; 11 min. Shows how harmful microbes are carried and spread; explains how they enter the body, overcome body defenses, and cause illness; stresses the importance of maintaining good health habits in order to prevent disease. Includes photomicrography and animated sequences.	Gr. 1 - * Gr. 7 - **	
25. Your Voice * EBF, 1949; 11 min., black & white Describes the four phases of voice production: respiration, phonation, resonance and articulation. Presents actual photographs of the vocal folds in operation. Animated drawings, together with demonstration material, explain the various processes. Emphasizes the role of proper exercises for improving the voice; illustrates the use of the voice in speaking and singing.	Gr. 7 - * Gr. 10 - **	

* Good
** Excellent

For discussion purposes only

SCIENCE FILMSTRIPS

(35 mm.)

for
Grade Five

Correlated to the Major Topics as found in the
Reorganized Science Curriculum

Minneapolis Public Schools
Science Department

For discussion purposes only

Grade Five

TABLE OF CONTENTS

Unit Title	Page Number	Color
Fall		
I. The Earth		
G. Weather and climate	1	Pink
Fall and Winter		
III. Energy		
G. Electrical energy	3	Yellow
Winter and Spring		
IV. The Universe		
A. Earth	5	Blue
B. Moon	6	Blue
C. Sun	7	Blue
D. Solar system	8	Blue
E. Stars and galaxies	9	Blue
Spring		
II. Living Things		
A. Life and life processes	11	Green
B. Classification	17	Green

The annotations for filmstrips found on the following pages were obtained from sources such as the Wilson's Filmstrip Guide, producers' catalogs, and the Library of Congress cards.

Fall

I. The Earth

G. Weather and climate

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. How Does Water Get Into the Air? * Jam Handy Organization, 1955; 27 fr., color (First Experiments About Weather Series, 6 f.s.), $4.75 each Art work illustrations. Johnny wonders where water comes from and how it gets up in the sky. Simple experiments show how water changes into water vapor and evaporates.	K. - ** Gr. 2 - ** Gr. 3 - *	Slow groups or review Excellent
2. What Is an Experiment? ** Jam Handy Organization, 1955, 24 fr., color (First Experiments About Weather Series, 6 f.s.), $4.75 each Art work illustrations. Billy discovers that an experiment is a test. He experiments to find the answers to his questions: Why does it get dark? Why does it rain? Why do airplanes fly?	Gr. 1 - ** Gr. 3 - **	Slow groups or review
3. What Is Wind? ** Jam Handy Organization, 1955; 31 fr., color (First Experiments About Weather Series, 6 f.s.), $4.75 each Art work illustrations. Through simple experiments with a pinwheel, a balloon and a plastic bag, Tommy discovers that wind is moving air and that air is real.	K. - * Gr. 1 - ** Gr. 3 - **	Slow groups or review

* Good
** Excellent

I. The Earth - G. (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
4. What Makes Things Dry Faster? ** Jam Handy Organization; 1955, 26 fr., color (First Experiments About Weather Series, 6 f.s.), $4.75 each Art work illustrations. Jane wishes she could make her painting dry faster. Through experiments, she learns that warm air and moving air make things dry faster.	Gr. 2 - ** Gr. 3 - **	Slow groups or review
5. Why Is the Night Cooler Than the Day? * Jam Handy Organization, 1955; 20 fr., color (First Experiments About Weather Series, Art work illustrations. Joe wonders why it is warmer in the day than it is in the evening. He uses a thermometer in experiments with the sunshine to learn the answer to his question.	K. - * Gr. 1 - ** Gr. 3 - **	Slow groups or review

* Good
** Excellent

SCIENCE FILMSTRIPS

Addendum

Grade Five

Additions to Page 2

I. The Earth

G. Weather & Climate

Climate *

Jam Handy; 39 fr., color

(Seasons, Weather & Climate) 1952
5 filmstrips, $5.95 ea., $29.00 set

How climate influences man's life. Reports from California, Alaska, Florida, American Samoa.

* Good
** Excellent
4-1-67

Fall and Winter

III. Energy

G. Electrical energy

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. Electromagnets and How They Work ** Jam Handy Organization, 1960; 38 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each An electromagnet solves a problem, how electromagnets are similar to and different from other magnets, how their polarity can be determined, how their strength can be increased, use of electromagnets.	Gr. 9 - *	
2. How Is Electricity Used in the Home? ** Jam Handy Organization, 1960; 47 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each How common appliances such as the toaster work, how an incandescent light works, how a motor works, how a switch is used to control the flow of electricity.	Gr. 9 - *	
3. How Most Electricity Is Produced ** Jam Handy Organization, 1960; 35 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each The principle of a generator is developed through demonstrations with a galvanometer and a magneto, how other forms of energy are changed to electrical energy through the use of the turbine.	Gr. 9 - *	

* Good
** Excellent

III. Energy - G. (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
4. Producing Small Amounts of Electricity ** Jam Handy Organization, 1960; 34 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each How dry cells and wet cells produce electricity through chemical action, simple experiments related to chemical action with common materials, how other forms of energy are changed to electrical energy.	Gr. 9 - *	
5. Using Electricity Safely ** Jam Handy Organization, 1960; 36 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each Why electricity can be dangerous, how short circuits and overloaded circuits cause fires, precautions to be taken in situations involving the safe use of electricity.	Gr. 9 - *	
6. What Is Current Electricity? ** Jam Handy Organization, 1960; 35 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each How the electron theory explains current electricity the advantages of this form of energy, how it can be changed to other forms of energy.	Gr. 9 - *	
7. What Is Static Electricity? ** Jam Handy Organization, 1960; 41 fr., color (Understanding Electricity Series, 7 f.s.) $5.75 each How the electron theory explains static electricity, experiments and everyday experiences which portray this phenomenon.	Gr. 9 - *	

* Good
** Excellent

SCIENCE FILMSTRIPS

Addendum

Grade Five

III. Energy

G. Electrical Energy

Electrical Energy: How We Convert It **

Heath; 31 fr., color

(Electrical Energy - 8A-5) 1954
8 filmstrips, $6.75 ea., $52.00 set

Electricity, in order to be put to use, must be converted into other forms of energy. This filmstrip reviews how electrical energy can be converted into heat, light, mechanical energy, or chemical energy. The filmstrip also points out that chemical energy can be converted into electrical energy.

The Sun And Its Energy **

Society for Visual Education; 50 fr., color

(Understanding Our Earth and Universe Series)
6 filmstrips; 3 records; $9.00 ea., $39.50 set

The purposes of this filmstrip are to show that the sun is a star, to show that the sun is made up of gases, to describe some of the different forms of the sun's radiation, to show the importance of the sun's energy to plant growth, to explain how the sun is the basic cause of weather, and to show some ways in which man is trying to use the sun's energy directly.

* Good
** Excellent
4-1-67

SCIENCE FILMSTRIPS

Addendum

Grade Five

IV. The Universe

A. Earth

The Sun And Our Seasons *

Jam Handy; 39 fr., color

(Seasons, Weather & Climate) 1952
5 filmstrips, $5.95 ea., $29.00 set

How hemispheres tipping toward or away from sun causes seasons, length of days, night. How temperatures of seasons are caused by length of days, directness of sun's rays, amount of air through which rays pass.

* Good
** Excellent
4-1-67

Winter and Spring

IV. The Universe

A. Earth

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. The Earth's Shape and Size ** Films for Education, 1958; 52 fr., color (The Story of the Universe I - The Earth and Its Moons Series, 6 f.s.), $7.50 each Students are introduced to proofs of the earth's shape and size discovered by ancient peoples plus some important modern principles.	Gr. 8 - **	Very difficult
2. Information from Satellites * Films for Education, 1958; 60 fr., color (The Story of Universe I - The Earth and Its Moons series, 6 f.s.), $7.50 each Considers rocket and satellite astronomy--why rockets are necessary and how they work, the general cause and nature of orbits, notions of circular and escape velocity, uses of satellites and space stations. The nature of light and its spectrum are brought up in answer to questions concerning transparency of the atmosphere. Possibilities of space travel are touched on.	Gr. 9 - **	Very difficult
3. What Is In Space? ** Jam Handy Organization, 1961; 31 fr., color (First Adventures In Space Series), $5.75 each Paintings. Shows what man may explore in outer space, including meteors, the moon, the planets, the sun and other stars and galaxies.	Gr. 8 - **	Also listed under: B. Moon C. Sun D. Solar system E. Stars and Galaxies

* Good
** Excellent

IV. The Universe

B. Moon

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. The Moon * Films for Education, 1958; 72 fr., color (The Story of the Universe I - The Earth and its Moon Series, 6 f.s.) $7.50 Earth's original satellite, the moon, is treated by bringing out ancient concepts and modern knowledge concerning distance, size and mass. Phases of the moon are explained, but the point is emphasized that we see only one side from the earth; the geography of this side is dealt with. Origins of this geography are suggested.	Gr. 8 - **	Very difficult
2. What Is In Space? ** Jam Handy Organization, 1961; 31 fr., color (First Adventures in Space Series, 6 f.s.), $5.75 each Paintings. Shows what man may explore in outer space, including meteors, the moon, the planets, the sun and other stars and the galaxies.	Gr. 8 - **	Also listed under: A. Earth C. Sun D. Solar System E. Stars and Galaxies

* Good
** Excellent

SCIENCE FILMSTRIPS

Addendum

Grade Five

Additions to Page 7

IV. The Universe

C. Sun

The Earth and Its Movements **

Society for Visual Education; 53 fr., color

(Understanding our Earth & Universe Series)
6 filmstrips; 3 records, $9.00 ea., $39.50 set

The purposes of this filmstrip are to show how the earth travels in three ways - at three speeds - at the same time, to explain why we have night and day, to explain why the earth travels in an orbit around the sun, and to show how the tilt of the earth on its axis is responsible for the seasons of the year.

The Moon and Its Relation To Earth **

Society for Visual Education; 60 fr., color

(Understanding our Earth & Universe Series)
6 filmstrips; 3 records, $9.00 ea., $39.50 set

The purposes of this filmstrip are to describe the moon and to show what the moon's surface is like, to show what it would be like to visit the moon, to identify the phases of the moon and show how they are caused and to explain how the moon causes the tides on earth.

The Sun and Our Seasons *

Jam Handy; 39 fr., color

(Seasons, Weather & Climate) 1952
5 filmstrips, $5.95 ea., $29.00 set

How hemispheres tipping toward or away from the sun causes seasons, length of days and nights. How temperatures of seasons are caused by length of days, directness of sun's rays, amount of air through which rays pass.

* Good
** Excellent
4-1-67

IV. The Universe

C. Sun

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. Our Sun * Films for Education, 1959; 44 fr., color (The Story of the Universe II - The Solar System Series, 6 f.s.), $7.50 each Our sun, the nearest star, is questioned closely in terms of its appearance, temperature, structure and what keeps it shining.	Gr. 8 **	Very difficult
2. What Is In Space? ** Jam Handy Organization, 1961; 31 fr., color (First Adventures In Space Series) $5.75 each Paintings. Shows what man may explore in outer space, including meteors, the moon, the planets, the sun and other stars and the galaxies.	Gr. 8 - **	Also listed under: A. Earth B. Moon D. Solar System E. Stars and Galaxies

* Good
** Excellent

IV. The Universe

D. Solar system

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. Exploring the Space Around Earth * Films for Education, 1958; 56 fr., color (The Story of the Universe I - The Earth and Its Moons Series, 6 f.s.) $7.50 each Considers rocket and satellite astronomy--why rockets are necessary and how they work, the general cause and nature of orbits, notions of circular and escape velocity, uses of satellites and space stations. The nature of light and its spectrum are brought up in answer to questions concerning transparency of the atmosphere. Possibilities of space travel are touched on.	Gr. 9 - *	Very difficult
2. What Is A Solar System? ** Benefic Press, 1961; 40 fr., color (6 f.s. in series) $ Presents basic facts about the solar system.	Gr. 8 - *	
3. What Is In Space? ** Jam Handy Organization, 1961; 31 fr., color (First Adventures In Space Series) $5.75 each Paintings. Shows what man may explore in outer space, including meteors, the moon, the planets, the sun and other stars and the galaxies.	Gr. 8 - **	Also listed under: A. Earth B. Moon C. Sun E. Stars and Galaxies

* Good
** Excellent

IV. The Universe

E. Stars and galaxies

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. Abnormal Stars * Films for Education, 1961; 32 fr., color, (The Story of the Universe III--The Stars Series, 6 f.s.) $7.50 each Interstellar matter, in some ways as important as the stars, needs careful treatment. Helps prepare a basis for understanding the final filmstrip on stellar evolution.	Gr. 8 - **	
2. On the Sky * Films for Education, 1961; 45 fr., color (The Story of the Universe III--The Stars Series, 6 f.s.)$7.50 each Colorful art work is supplemented by photographs where only these will do justice to subject. This filmstrip reviews the night sky including the visible objects of the solar system, but emphasizes major constellations and bright stars.	Gr. 8 - **	
3. What Is In Space? ** Jam Handy Organization, 1961; 31 fr., color (First Adventures in Space Series) $5.75 each Paintings. Shows what man may explore in outer space, including meteors, the moon, the planets, the sun and other stars and the galaxies.	Gr. 8 - **	Also listed under: A. Earth B. Moon C. Sun D. Solar System

* Good
** Excellent

SCIENCE FILMSTRIPS

Addendum

Grade Five

IV. The Universe

E. Stars & Galaxies

The Stars and Outer Space **

Society for Visual Education; 61 fr., color

(Understanding Our Earth & Universe Series)
6 filmstrips; 3 records, $9.00 ea., $39.50 set

The purposes of this filmstrip are to show a method of measuring space; to show a method of measuring the temperatures of stars; to define constellation, nebula, and galaxy and show examples of each; and to explain how comets differ from other heavenly bodies.

* Good
** Excellent
4-1-67

Spring

II. Living Things

A. Life and life processes

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. Animal Behavior ** Curriculum, rev. 1960; 29 fr., color (Stimulus and Response Series, 5 f.s) $4.50 each Explains that food getting behavior in "advanced" animals is more complex than in "simple" animals; and that animals respond to the need for self-protection, mating, and caring for their young.	Gr. 7 - **	
2. Bats - Helpful and Harmful ** Jam Handy Organization, 1962; 38 fr., color (Animals - Helpful and Harmful series, 6 f.s.), $5.75 each. The distinctive features of bats; false impressions about these animals. How they are helpful by destroying harmful insects and providing fertilizer. How they can be harmful.	Gr. 7 - **	Also listed II-B
3. The Behavior of Plants * Curriculum, rev. 1960; 30 fr., color (Stimulus and Response ser., 5 f.s.) $4.50 each Explains typical plant responses to stimuli such as sunlight, moisture, and the pull of gravity.	Gr. 7 - **	

* Good
** Excellent

II. Living Things - A. (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
4. The Behavior of Simple Animals * Curriculum, rev. 1960; 29 fr., color (Stimulus and Response ser., 5 f.s.) $4.50 each Shows that simple microscopic animals have the same fundamental patterns of behavior that are seen throughout the animal kingdom.	Gr. 7 - **	
5. Birds - Helpful and Harmful ** Jam Handy Organization, 1962; 42 fr., color (Animals - Helfpful and Harmful Series, 6 f.s.), $5.75 each The characteristics of birds. How they are alike. How they are different; their many helpful functions in the life of man. How some birds can be destructive or annoying.	Gr. 7 - **	Also listed II - B
6. Harmful Insects ** Jam Handy Organization, 1962; 45 fr., color (Animals - Helpful and Harmful Series, 6 f.s), $5.75 each The great variety of harmful insects. How and why they are so harmful to man in matters of health and economics. What man and nature do to combat their harmfulness.	Gr. 4 - * Gr. 7 - **	
7. Helpfuul Insects ** Jam Handy Orgnaization, 1962; 39 fr., color (Animals - Helpful and Harmful Series, 6 f.s.), $5.75 each The characteristics of all insects; the bee, the most helpful insect. Some moths, beetles and other insects and why they are so valuable to man.	Gr. 4 - * Gr. 7 - **	Also listed II-B

* Good
** Excellent

II. Living Things - A. (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
8. The Importance of Air in Nature ** Jam Handy Organization, 1961; 41 fr., color, (Understanding the Atmosphere Series, 6 f.s.), $5.75 each The importance of oxygen, nitrogen, carbon dioxide and water vapor is clearly demonstrated. Logical picture sequences explain oxidation and the ways in which gases of the air are exchanged in nature.	Gr. 4 - * Gr. 7 - **	
9. Insects and Their Ways ** Row-Peterson Textfilms, 1956; 44 fr., color Basic Science Education Series (General Science Group) 3 f.s., $6.00 each Insects live in many different kinds of places. More than half of all the kinds of animals are insects. Every insect has six legs, 3 body parts, 2 antennas. The great group of insects is divided into smaller groups with distinctive characteristics. Some insects show complete metamorphosis; others, incomplete metamorphosis. Some insects are harmful to us, some helpful. Insects are protected in various ways. Some insects are social, some solitary.		
10: Insects: Harmful and Useful ** EBF 1961; 45 fr., color (The Insects Series, 4 f.s.) $6.00 each Tells some ways insects transmit diseases. Shows how some harmful insects are controlled. Explains how insects destroy crops. Points out how some insects benefit mankind. Introduces some natural enemies of insects.	Gr. 7 - **	

* Good
** Excellent

II. Living Things - A. (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
11. Insects That Live in Societies * EBF 1961; 52 fr., color (The Insects Series, 4 f.s.), $6.00 each Describes how the term "social" applies to some insects. Tells how the functions of social insects vary among individuals within colonies. Explains how new colonies of social insects are started. Reveals some important aspects of the relationship of social insects to man.	Gr. 7 - **	Difficult vocabulary
12. Learned Behavior ** Curriculum, rev. 1960; 29 fr., color Stimulus and Response Series, 5 f.s.) $4.50 each Discusses unlearned and learned behavior in animals and in people, and explains the importance of learned behavior in our lives.	Gr. 7 - **	
13. The Life Cycles of Insects ** EBF, 1961; 51 fr., color; (The Insects Series, 4 f.s.), $6.00 each Explains what is meant by metamorphosis. Shows the kinds of metamorphosis. Portrays activities characteristic of the stages of metamorphosis. Tells some characteristics of metamorphosis which aid the survival of the species.	Gr. 7 - **	Difficult vocabulary
14. Snakes - Helpful and Harmful ** Jam Handy Organization, 1962; 44 fr., color (Animals - Helpful and Harmful Series, 6 f.s.), $5.75 each The general characteristics of snakes; how most help man by destroying harmful rodents; the four North American poisonous snakes; how they can be recognized; their general range.	Gr. 7 - **	Also listed II-B

* Good
** Excellent

II. Living Things - A. (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
15. Spiders - Helpful and Harmful ** Jam Handy Organization, 1962; 41 fr., color (Animals - Helpful and Harmful Series, 6 f.s.), $5.75 each How spiders are distinguished from insects; their helpfulness through such functions as eating harmful insects; different types of spiders and webs; the harmful black widow.	Gr. 7 - **	Also listed II-B
16. Telling Trees Apart ** Row-Peterson Textfilms, 1956; 44 fr., color Basic Science Education Series (Plant Study Group* 4 f.s., $6.00 each Trees are our largest plants. There are two great groups of trees - conifers and broad-leaved trees. Most conifers are evergreens; most broad-leaved trees lose their leaves in the fall in regions of cold winter. Trees can be identified by their leaves, buds, flowers, fruits, shape, color, and unusual features such as thorns and knees		
17. What Is An Insect? ** EBF 1961; 54 fr., color (The Insects series, 4 f.s.) $6.00 each Describes and visualizes the structural characteristics of insects. Explains the origin of insects. Shows some structural differences between some insects. Portrays some advantages insects have in their struggle for survival.	Gr. 7 - **	Difficult vocabulary

* Good
** Excellent

SCIENCE FILMSTRIPS

Addendum

Grade Five

II. Living Things

A. Life & Life Processes

Forest Conservation Today **

SVE Educational Filmstrips; 46 fr., color

(Conservation Series) 1963
7 filmstrips; $6.00 ea., record, $3.00 ea., $49.50 set

Role forests play in our lives and economy. Causes, results of forest depletion, need for education of importance of forests.

How Green Plants Grow *

Jam Handy; 24 fr., color

(Plants Around Us) 1964
6 filmstrips; $5.75 ea., $31.50 set

Describes the generally common process of plant growth and how this growth takes place.

Land Conservation Today **

SVE Educational Filmstrips; 51 fr., color

(Conservation Series) 1963
7 filmstrips, $6.00 ea., record, $3.00 ea., $49.50 set

Recent living changes have affected rural and urban land use. Proper utilization and preservation are emphasized.

Mineral Conservation Today **

SVE Educational Filmstrips; 52 fr., color

(Conservation Series) 1963
7 filmstrips, $6.00 ea., record, $3.00 ea., $49.50 set

Requirements of high living standards and industrialization have increased consumption of irreplaceable minerals; conservation methods are explored.

* Good
** Excellent
4-1-67

SCIENCE FILMSTRIPS

Addendum

Grade Five II. A. continued

Additions to Page 16

Soil Conservation Today **

SVE Educational Filmstrips; 41 fr., color

(Conservation Series) 1963
7 filmstrips, $6.00 ea., record, $3.00 ea., $49.50 set

Illustrates types of soil erosion, depicts agricultural methods of conserving soil, minerals, croplands, grasslands, forests.

Urban Conservation Today **

SVE Educational Filmstrips, 43 fr., color

(Conservation Series) 1963
7 filmstrips, $6.00 ea., record, $3.00 ea., $49.50 set

Shows inter-relation of problems of both central city and outlying areas due to increasing population. Complexities of solutions discussed.

Water Conservation Today **

SVE Educational Filmstrips; 39 fr., color

(Conservation Series) 1963
7 filmstrips, $6.00 ea., record, $3.00 ea., $49.50 set

Study of remedies for water problems -- protection of watersheds, efficient use of water, prevention of water pollution.

Wildlife Conservation Today **

SVE Educational Filmstrips; 39 fr., color

(Conservation Series) 1963
7 filmstrips, $6.00 ea., record, $3.00 ea., $49.50 set

Shows the value of wildlife and provisions being made to protect and stimulate its growth.

* Good
** Excellent
4-1 67

II. Living Things

B. Classification

Name and Description of Filmstrip	Other Grade Placements	Remarks
1. Animal and Plant Communities: City ** McGraw-Hill Book Co., 1961; 40 fr., color (Interdependence of Living Things Series, 6 f.s.), $6.75 each, $36.50 set In the city, as elsewhere, animal and plant associations and food chains exist. The filmstrip describes how normal succession is controlled and how animals and plants are able to survive in this man-made biologically harsh environment.	Gr. 7 - *	
2. Animal and Plant Communities: Field * McGraw-Hill Book Co., 1961; 40 fr., color (Interdependence of Living Things Series, 6 f.s.), $6.75 each, $36.50 set Although man-made, the field is a community with its own plant and animal associations. This filmstrip discusses how man prevents natural succession by channeling the energy of the field for his purposes. It then shows the procession of plants and animals which will occupy the field that is left untended, finally completing the transition from field to forest.	Gr. 7 - *	
3. Animal and Plant Communities: Forest * McGraw-Hill Book Co., 1961; 40 fr., color (Interdependence of Living Things Series, 6 f.s.), $6.75 each, $36.50 set This filmstrip examines the composition and structure of the forest, its plant and animal associations, and the variations that occur in these associations with the normal process of change in the forest.	Gr. 4 - ** Gr. 7 - **	Difficult Vocabulary

* Good
** Excellent

II. Living Things - B (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
4. Bats - Helpful and Harmful ** Jam Handy Organization, 1962; 38 fr., color (Animals - Helpful and Harmful Series, 6 f.s.), $5.75 each The distinctive features of bats; false impressions about these animals. How they are helpful by destroying harmful insects and providing fertilizer. How they can be harmful.	Gr. 7 - **	Also listed II-A
5. Beaks and Feet of Birds ** Row-Peterson Textfilms, 1958; 40 fr., color Basic Science Education Series (Bird Study Group, 5 f.s.) $6.00 each Relates the adaptation of beaks and feet to the diet and life habits of birds. Wading feet, swimming feet, perching feet, talons, and other groupings are shown. Beaks shown include the all purpose beak, the chisel beak, the sieve beak, and many others including some exotics. Specific examples prove interesting.		
6. Birds - Helpful and Harmful ** Jam-Handy Organization, 1962; 42 fr., color (Animals - Helpful and Harmful Series, 6 f.s.), $5.75 each The characteristics of birds: How they are alike; how they are different; their many helpful functions in the life of man; how some birds can be destructive or annoying.	Gr. 7 - **	Also listed II-A

*Good
** Excellent

II. Living Things - B (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
7. Dependent Plants ** Row-Peterson Textfilms, 1956, 44 fr., color Basic Science Education Series (Dependent Plants Group) 2 f.s., $6.00 each Differences between dependent plants and chlorophyll-bearing plants. Dependent plants with flowers or leaves or both. Differences between seeds and spores. Symbiosis between fungi and other plants. Importance of dependent plants in soil-building, in industrial processes, in serving as checks on other organisms. Types of dependent plants: fungi, yeasts, slime molds, bacteria, lichens, and the functioning of each.		
8. Helpful Insects ** Jam Handy Organization, 1962; 39 fr., color (Animals - Helpful and Harmful Series, 6 f.s.) $5.75 each The characteristics of all insects; the bee, the most helpful insect. Some moths, beetles and other insects and why they are so valuable to man.	Gr. 4 - * Gr. 7 - **	Also listed II-A
9. Living Things ** Row-Peterson Textfilms, 1956, 43 fr., color, Basic Science Education Series (General Science Group) 3 f.s., $6.00 each A very brief survey of living things. It describes the characteristics of living things as opposed to non-living. It gives a brief overview of the major classifications of living things. Plants - Animals - Seed producing plants - Those that don't produce seeds, etc. Many common examples are given. Animal classification is well done to the five classes of vertebrates, mammals, fish, birds, reptiles, and amphibians. The distinguishing characteristics of each were given.		

* Good
** Excellent

II. Living Things - B (continued)

Name and Description of Filmstrip	Other Grade Placements	Remarks
10. Mushrooms ** Row-Peterson Textfilms, 1956, 45 fr., color Basic Science Education Series (Dependent Plants Group), 2 f.s., $6.00 each Types of mushrooms that live on different kinds of food supply. Functioning of such fungi in restoring to the soil the food elements needed to sustain living things. Size, color, and habitat range of rushrooms. Making of spore prints. Nature of spores, and various ways in which they are disseminated. Edible and non-edible mushrooms. Symbiosis between mushrooms and other plants. Throughout this film, great care is taken to point out that edible and non-edible mushrooms can look much alike, and that only an expert can distinguish them.		
11. Snakes - Helpful and Harmful ** Jam Handy Organization, 1962; 44 fr., color, (Animals - Helpful and Harmful Series, 6 f.s.), $5.75 each The general characteristics of snakes; how most help man by destroying harmful rodents; the four North American poisonous snakes; how they can be recognized; their general range.	Gr. 7 - **	Also listed II-A
12. Spiders - Helpful and Harmful ** Jam Handy Organization, 1962; 41 fr., color (Animals - Helpful and Harmful Series, 6 f.s.) $5.75 each How spiders are distinguished from insects; their helpfulness through such functions as eating harmful insects; different types of spiders and webs; the harmful black widow.	Gr. 7 - **	Also listed II-A

* Good
** Excellent

II. Living Things - B (continued)

Name and Description of Filmstrips	Other Grade Placements	Remarks
13. Telling Trees Apart **		

Row-Peterson Textfilms, 1956, 44 fr., color
Basic Science Education Series (Plant Study Group), 4 f.s., $6.00 each

Trees are our largest plants. There are two great groups of trees -- conifers and broad-leaved trees. Most conifers are evergreens; most broad-leaved trees lose their leaves in the fall in regions of cold winters. Trees can be identified by their leaves, buds, flowers, fruits, shape, color, and unusual features such as thorns and knees.

* Good
** Excellent

JLP:la
11-9-64

EQUIP. & SUPPLIE

BASIC SCIENCE SUPPLIES FOR ELEMENTARY SCHOOLS February 1966

Item No.		Unit	Unit Price
32-0140	ALCOHOL, Denatured	quart	.34
17-0100	ALUMINUM FOIL, 15" x 50', to waterproof table tops	roll	.62
17-0110	ALUMINUM FOIL, 18" x 50', for use under an aquarium or terrarium	roll	1.03
28-0100	ANIMAL PEN, 18" x 24" x 18" high	each	6.61
28-0105	ANIMAL PEN, cage, 9" x 9" circular	each	4.55
28-0110	ANT HOME, Turtox 220A167	each	7.50
	AQUARIUMS, TERRARIUMS AND SUPPLIES:		
28-0030	ACID NEUTRALIZER	ounce	.45
28-0040	AERATOR, Saxon	each	6.00
28-0200	AQUARIUM, 3 gallon, seamless	each	6.34
28-0300	AQUARIUM, 6 gallon	each	9.07
28-0340	AQUARIUM CEMENT	lb.	.60
	AQUARIUM COVER (include pattern w/requisition)		
28-0390	9-7/8" x 5-3/4", clear plexiglass	each	.42
28-0400	9-7/8" x 5-3/4", glass, double strength	each	1.00
28-0490	9-1/2" x 17-1/2", clear plexiglass	each	1.27
28-0500	9-1/2" x 17-1/2", glass, double strength	each	1.23
28-0600	AQUARIUM AND TERRARIUM SEALER	tube	.30
28-2100	CHARCOAL, Chunk	5# bag	.43
28-3000	DIP NET, 3" wide, 3-1/2" deep	each	.35
28-3020	DIP TUBE, plastic, 16", no scraper attachment	each	.90
28-3025	AQUARIUM METAL SCRAPER, long handle	each	.60
28-3290	FEEDING RING, 2"	each	.20
47-3260	GLASS SCRAPER, all metal	each	.18
47-0340	BLADES for above scraper	each	.02
28-4160	GRANITE CHIPS	lb.	.034
28-4180	GRAVEL	lb.	.05
28-7460	SAND	lb.	.15
28-8100	SOIL, sterile	bushel	1.50
28-9320	TEMPERATURE CONTROL OUTFIT: Thermostat #340 to include one of the following:	each	5.85
28-4310	PENCIL HEATER, 25 w, for aquarium, 1 to 3 gallon	each	2.00
28-4320	PENCIL HEATER, 50 w, for aquarium, 4 to 6 gallon	each	2.00
28-4330	PENCIL HEATER, 75 w, for aquarium, 7 to 15 gallon	each	2.75
28-0700	ASPIRATOR, Chapman pump, Cenco 13205-3, w/adapters to connect to sink	each	3.25
28-0705	HOSE FOR ASPIRATOR, black (indicate footage needed)	ft.	.27
28-0800	BALANCE, demonstration, clamp and support only (must order meter stick #28-5380 to complete set)	each	2.60

BASIC SCIENCE SUPPLIES FOR ELEMENTARY SCHOOLS

Item No.		Unit	Unit Price
28-0820	BALANCE, TRIPLE BEAM, stainless steel, capacity 610 gms Note: by use of auxiliary weights this balance can be used to a maximum of 2610 gms	each	15.35
28-0825	AUXILIARY WEIGHT SET, for use with Triple Beam Balance. Increases capacity from 610 gms to 2610 gms. Set consists of 2 1,000 gm weights and 1 500 gm weight.	set	4.50
28-0830	WEIGHT, 500 gm, for use with Triple Beam Balance (to replace any lost in Auxiliary Weight Set)	each	1.50
28-0835	WEIGHT, 1,000 gm, for use with Triple Beam Balance (to replace any lost in Auxiliary Weight Set)	each	1.50
28-0840	BALL AND RING	each	4.11
15-1200	BALLOONS, rubber	doz.	.46
28-0900	BAROMETER, ANEROID, 6" diameter, round wooden case	each	3.33
28-2150	BATTERY CELL HOLDER for "D" dry cell, mounted on board with Fahnestock clips for easy connection	each	.50
	BEAKER, Griffin, low form, Pyrex		
28-0940	100 ml	each	.40
28-0960	150 ml	each	.39
28-0980	250 ml	each	.39
28-1000	400 ml	each	.46
28-1020	BEAKER, Griffin, low form, stainless steel, 600 ml	each	2.97
28-1030	BELL, DOOR, electric, D.C., 2-1/2" diameter	each	1.64
28-1060	BELL OUTFIT, electric, dry cell, push button, 1 lb annunciator wire and staples	each	4.12
28-1500	BOTTLES, 4 oz. wide mouth (gas collecting bottle)	doz.	.66
28-1520	BOTTLES, 8 oz. wide mouth (gas collecting bottle)	doz.	.89
28-1540	BOTTLES, 4 oz. (baby food jar type with bakelite screw cap)	doz.	1.61
28-1570	BROM THYMOL BLUE, Crystaline, Free acid form, Harleco #862 (to detect the presence of carbon dioxide -- for the study of the constituents of air and the respiratory activities of plants and animals)	1-gram bottle	1.50
28-1600	BRUSH, Test tube, 3/4" x 3-1/2"	each	.13
28-1620	BURNER, Alcohol lamp, glass, 4 oz.	each	.74
28-1640	BURNER, Turner, liquid petroleum, tank + LP, Bunsen-type	each	7.95
70-4550	REPLACEMENT TANK	each	.98
28-1700	BUZZER, electric	each	1.73

BASIC SCIENCE SUPPLIES FOR ELEMENTARY SCHOOLS

Item No.		Unit	Unit Price
28-2010	CALCIUM HYDROXIDE SOLUTION, limewater (Also see Lime Water Tablets #28-4810)	1# bottle	.60
28-2030	CANDLES, Paraffin	doz.	.48
28-2040	CASTER CUPS, glass	each	.10
28-2050	CAT'S SKIN, half	each	3.64
28-2060	CELL, student's demonstration	each	3.15
28-2110	CHIMNEY, lamp	each	1.00
28-2120	CLAMP, Burette	each	1.20
28-2140	CLAMP, pendulum	each	2.30
28-2160	CLIP, Fahnestock, to be used to mount electrical apparatus (10 in package)	pkg.	.17
28-2200	COMPASS, magnetic, 16 mm diameter	each	.25
28-2240	COMPASS, magnetic, about 45 mm diameter	each	.70
28-2300	COMPOUND BAR, bi-metal	each	.78
28-2400	CONDUCTOMETER, four 5" wires on handle, overall length 13 inches	each	2.05
28-2500	CORKS, assorted, xx quality, sizes 0-11 (100 in bag)	bag	1.35
28-2540	CORK BORER, set of 6, 1/2" largest borer	set	6.20
28-2560	COTTON, absorbent, not sterilized	lb.	.90
28-2600	CULTURE DISHES, Petri, Pyrex, 100 mm x 15 mm	pair	.60
17-3380	CUPS, measuring, Set of 4 (1 C, 1/2 C, 1/3 C, 1/4 C)	set	.36
28-2700	CYLINDER, graduated, Tuttle, short form, 100 ml capacity	each	2.70
28-2720	CYLINDER, hydrometer jar, 275 ml capacity, 13-38" high	each	2.40
28-3015	DISHES, evaporating, Coors 430, 75 mm diameter, 30 mm high, 70 ml capacity	each	.47
28-3040	DISSECTING NEEDLE, wooden handle, bent needle	each	.10
28-3050	DISSECTING NEEDLE, wooden handle, straight needle	each	.07
28-3100	DROPPER, medicine, (12 to pkg)	pkg.	.46
28-3140	DROPPING BOTTLE, 30 ml	each	.35
59-0130	DRY CELL, 1½ volt, #6, diameter 2-1/2", height 6"	each	.64

BASIC SCIENCE SUPPLIES FOR ELEMENTARY SCHOOLS

Item No.		Unit	Unit Price
28-3200	ELECTRIC PLATE, 3 heat, 1000 watt, 110 volt	each	6.14
28-3240	ELECTROMAGNET, horseshoe type	each	11.40
28-3260	ELECTROSCOPE, flask form, 250 ml, Pyrex Erlenmeyer flask	each	2.85
28-3280	ETHYL ACETATE, for killing insects	lb.	1.26
28-3300	FEHLING'S SOLUTION, A	16 oz bottle	1.20
28-3320	FEHLING'S SOLUTION, B	16 oz bottle	1.55
28-3400	FILE, Triangular, 4"	each	.38
28-3500	FILTER PAPER, qualitative, 100 circles per package, 11 cm diameter	pkg.	.44
28-3600	FLASK, Erlenmeyer, narrow mouth, Pyrex, 250 ml	each	.48
28-3620	FLASK, Erlenmeyer, narrow mouth, Pyrex, 500 ml	each	.61
28-3800	FUNNEL, plastic, 73 mm, or 2-7/8" top diameter	each	1.14
28-4000	FUNNEL, Pyrex, 65 mm or 2-1/2" top diameter	each	.75
28-4100	FUNNEL, thistle top, 30 cm or 12" length, 35 mm or 1-1/4" diameter	each	.36
	GLOVES, rubber:		
28-4120	size 8	pair	.80
28-4130	size 9	pair	.80
28-4140	size 10	pair	.80
28-4200	GYROSCOPE, simple form, 5.5 cm diameter, support and starting cord	each	1.25
28-4360	HYDROCHLORIC ACID (HCL)	lb.	1.03
28-4400	HYGROMETER, Humidiguide, direct reading	each	9.00
28-4500	IRON FILINGS	1# carton	.38
28-4600	JAR, battery, cylindrical, 1 gallon	each	1.42
28-4800	LAMP, incandescent, miniature, 2-1/2 volt maximum, screw base	each	.25
28-4805	LENSES, demonstration set, 3.75 cm diameter, 6 in set	each	5.25
28-4810	LIME WATER TABLETS (See Calcium Hydroxide Solution, #28-2010)	each	.0075
28-4820	LITMUS PAPER, blue, 100 strips in vial	vial	.09
28-4840	LITMUS PAPER, neutral, 100 strips in vial	vial	.09
28-4860	LITMUS PAPER, red, 100 strips in vial	vial	.09

Item No.		Unit	Unit Price
28-4940	MAGNETS, bar, steel, 2 in box with keepers	set	1.80
28-5100	MAGNETS, ceramic cylinders, 3/8" x 1/8", #1054	each	.03
28-5000	MAGNETS, ceramic cylinders, .52" x .25", #866	each	.03
28-5140	MAGNETS, "floating"	each	3.25
28-5200	MAGNETS, horseshoe, 2.8 cm	each	.60
28-5240	MAGNETS, horseshoe, 4 cm	each	2.20
28-5250	MAGNETS, natural, lodestone	each	.22
28-5260	MAGNETIC NEEDLE, on stand	each	2.45
28-7100	MAGNIFIER, round, 3" diameter reading glass with handle, 2x to 3x	each	1.25
28-5300	MAGNIFIER, small, premium plastic, 3-5/8" long, fitted with two spherical convex lens (3x and 7x) and two cylindrical magnifiers	each	.31
28-5280	MAGNIFIER, tripod, 10x	each	1.10
28-5320	MAT, asbestos, 10" x 16"	each	.65
28-5340	MAT, wire gauze, asbestos center, 4 inch	each	.21
28-5380	METER STICK, maple, metric and English scales	each	.85
28-5400	MICROSCOPE, ELECTRIC, including: 50X and 100X objectives, 12 prepared slides, micromount cards, one 32 page booklet, "The Microscope in Elementary Science", and wood case	each	18.18
18-4600	ELECTRIC LIGHT BULB, 6 watt, 115 volt, candelabra bayonet base (replacement bulb for item #28-5400)	each	.18
28-5410	MICROSCOPE, model ESM, 100X Bausch and Lomb (No Sub) Cat. 31-33-03 (Price includes illuminator, item #28-5425)	each	15.00
28-5420	MICROSCOPE, ZOOMSCOPE, Model STZ 100 Bausch and Lomb (No Sub) Cat. 31-21-03 Magnification 25x through 100 x Zoom. (Price includes illuminator, item #28-5425)	each	53.00
28-5425	ILLUMINATOR, portable, Bausch and Lomb (No Sub) Cat. 31-33-03 Rite-Lite	each	3.00
28-5426	LAMP, replacement for microscope illuminator (Rite-Lite) Item #28-5425, 9-3/4 watt, candelabra, screw base, Bausch and Lomb, (No Sub) Cat. 31-31-40	each	.15
28-5500	MICROSCOPE SLIDES, culture	each	.12
28-5600	MICROSCOPE SLIDES, plain, 72 per box	box	1.10
28-5700	MIRROR, concave and convex, 75 cm diameter, 20 cm focus	each	1.00
28-5740	MIRROR, plane, square, 10 cm x 10 cm	each	.20
28-5800	MORTAR AND PESTLE, porcelain, Coors 522, 100 mm diameter, 60 mm high, 115 mm pestle length	set	1.66
28-5840	MOTOR, St. Louis, with 2 bar magnets; electromagnet attachment, $6.15	each	13.50

Item No.		Unit	Unit Price
28-5860	NEEDLES, DARNING, 10 in pkg.	pkg.	.25
28-5880	NEEDLES, KNITTING, 12 in pkg.	pkg.	.55
28-5900	PAN, Dissecting, 12" x 7-1/2" x 5/8" deep	each	1.20
28-5910	PAN, METAL, vitreous enamel, 16-3/8" x 10" x 2-1/8"	each	2.50
28-5920	PAN, METAL, vitreous enamel, 20-1/2" x 12-3/4" x 2-3/8"	each	3.64
28-5930	PAPER, BLUEPRINT, 5 x 7, 24 sheets	pkg.	.49
28-5940	PAPER, BLUEPRINT, 8 x 10, 24 sheets	pkg.	1.29
28-5960	PINS, SILK, #2, for mounting insects (100 per pkg.)	pkg.	.43
28-5980	PITH BALLS, 12	pkg.	.80
28-6100	PLANT FOOD, "Plantabbs", 100 in pkg.	pkg.	.20
28-6000	PLANETARIUM, Universal, shows day and night, seasons, length of day, phases of moon, earth-sun-moon phases, includes manual	each	24.00
28-6200	PLATES, glass, flat, 12 to pkg. 2" x 2" x 1/16" thick	pkg.	.30
28-6220	POTS, FLOWER, unglazed earthenware, 4" diameter	each	.10
28-6240	PRISM, equilateral, flint glass, 75 mm long	each	2.00
28-6300	PULLEY, double, Bakelite	each	1.15
28-6340	PULLEY, single, Bakelite	each	.80
28-6400	PULLEY, double tandem, Bakelite	each	1.55
28-6440	PULLEY, triple tandem, Bakelite	each	2.05
28-6500	PUMP, model, plastic, force	each	5.65
28-6540	PUMP, model plastic, lift	each	4.95
28-7000	RADIOMETER	each	.80
28-7140	RECEPTACLE, screw base, for incandescent lamp, miniature, item #28-4800 (unmounted)	each	.25
28-7145	RECEPTACLE, screw base, for incandescent lamp, miniature, (mounted on board with Fahnestock clips for easy connection) -- 2 lamps included	each	.94
28-7020	RAIN GAUGE, wedge shape	each	3.95
28-7300	ROD, FRICTION, glass, 300 mm x 13 mm	each	1.10
28-7340	ROD, FRICTION, hard rubber, 250 mm x 13 mm	each	.70
28-7360	ROD, soft iron (used as electromagnet core)	each	.25
28-7400	RUBBER STOPPERS, assorted sizes, 00-8 (solid, one-hole and two-hole)	2 lb.	2.40

BASIC SCIENCE SUPPLIES FOR ELEMENTARY SCHOOLS

Item No.		Unit	Unit Price
17-5800	SALT SHAKER, glass, for iron filings	each	.08
28-7480	SCALE, balance, spring dial type, 250 gms or 9 oz. capacity, Cenco 5410 - or equal, (to determine the weight of objects weighing less than one-half pound and small forces)	each	2.25
28-7490	SCALE, balance, spring, dial type, 500 gms or 18 oz. capacity, Cenco 5510 - or equal, (to determine the weight of objects weighing one pound or less and to measure small forces)	each	2.25
28-7500	SCALE, balance, spring, dial type, 2,000 gms or 72 oz. capacity	each	2.25
28-8000	SCIENCE KIT AND MANUAL, contains almost all necessary initial equipment for elementary science	each	42.00
28-8040	SILK PAD, exciting	each	.55
28-8200	SPOON, DEFLAGRATING, iron, 3/4" diameter cup, total length 15"	each	.26
28-8300	SUPPORT, iron, rectangular base, 4-7/8" x 8", w/rod	each	1.90
	SUPPORT, ring with clamp		
28-8400	2-1/2" inside diameter	each	.95
28-8500	3-3/8" inside diameter	each	1.05
28-8520	SWITCH, KNIFE (unmounted) single pole, single throw	each	.40
28-8525	SWITCH, KNIFE (mounted on board with Fahnestock clips for easy connection) single pole, single throw	each	1.13
59-0570	SWITCH, PUSH BUTTON (unmounted)	each	.50
28-8530	SWITCH, PUSH BUTTON (mounted on board with Fahnestock clips for easy connection)	each	1.08
28-8600	TELEPHONE RECEIVER	each	5.00
28-8640	TELEPHONE TRANSMITTER	each	4.00
28-8700	TEST TUBES, Pyrex, 6" x 5/8"	each	.0508
28-8740	TEST TUBE CLAMP (Holder)	each	.11
28-8800	TEST TUBE RACK, wood, 6 holes and 6 pins	each	.70
28-9000	THERMOMETER, Celsius, (Centigrade) laboratory type, (-10°C to 110°C)	each	1.80
28-9005	THERMOMETER, Celsius, (Centigrade) student type, (-30°C to 50°C) inexpensive thermometer mounted on plastic backing	each	.15
28-9040	THERMOMETER, Fahrenheit, laboratory type, (0°F to 230°F)	each	1.40
28-9050	THERMOMETER, Fahrenheit, student type	each	.15
28-9100	THERMOMETER, metal, protected bulb, white enamel, scale in black	each	1,08
28-9200	THERMOMETER, outdoor, metal, protected bulb, mounting brackets, swivel type	each	1.53
28-9300	THERMOMETER, wooden back, natural finish	each	1.20

Item No.		Unit	Unit Price
16-3420	THREAD, black No. 50	spool	.09
16-3520	THREAD, white No. 50	spool	.09
28-9340	TONGS, beaker, Fisher improved	pair	6.50
28-9360	TONGS, crucible, Parkerized steel	pair	.38
	TOOLS:		
32-4740	HAMMER, claw, 10 oz. head	each	2.24
28-4300	HAMMER, geologist, 22 oz. head	each	5.50
32-6300	PLIERS, combination, adjustable, 6"	each	.50
32-7460	SAW, HACK, adjustable	each	1.18
32-0930	BLADE, HACKSAW, 12", 14 teeth	each	.10
32-7550	SCREWDRIVER, 4" blade, Stanley #20	each	.71
32-8750	SHEARS, tinners snips, 3" cutting length, Wiss #9	pair	2.29
28-9400	TUBING, GLASS, lead-potash, 6 mm outside diameter	lb.	.55
28-9420	TUBING, RUBBER, 3/16", black	ft.	.27
28-9440	TUBING, RUBBER, 3/16", red	ft.	.27
	TUNING FORK, unmounted		
28-9500	128 vps	each	5.50
28-9520	256 vps	each	5.50
28-9540	320 vps	each	5.15
28-9560	384 vps	each	5.15
28-9580	512 vps	each	5.00
15-9200	TWEEZER, length - 4-5/8"	each	.31
12-8600	VERMICULITE	5# bag	.20
28-9600	VOLT-AMMETER, pocket type, DC, range 0-10 volts, 0-35 amperes	each	3.60
28-9640	WATCH GLASS, Pyrex, 75 mm diameter	each	.15
28-9700	WEATHER VANE, with base, metal, directions plainly marked	each	.83
28-9720	WEIGHTS, BALANCE, AVOIRDUPOIS, iron, class T, 1/2 oz. to 1 lb. (set of 8)	set	5.00
28-9740	WEIGHTS, METRIC, HOOKED, 10 gm - 1 kgm	set	14.25
28-9750	WEIGHTS, BALANCE, METRIC, in wood block, 1 gm - 500 gm	set	8.25
28-9770	WIRE, copper, annunciator, #22, vinylite covered	1# coil	2.34
28-9780	WIRE, iron, 17 gauge	4 oz spool	.34
28-9800	WOOD SPLINTS, 500	pkg.	.63

BASIC SCIENCE SUPPLIES FOR ELEMENTARY SCHOOLS

Item No.		Unit	Unit Price
	BIRD CARDS, Audubon, postal card size, 50:		
28-1100	Summer	box	1.20
28-1200	Winter	box	1.60
28-1300	Spring	box	1.60
28-1400	BIRD CHARTS, Audubon, 20" x 30", set of 4: Winter, Summer, Game Birds, and Birds of Prey	set	3.55
28-7200	ROCK CYCLE CHART	each	10.95
	ROCK COLLECTION:		
28-7210	KINDERGARTEN, 5 specimens to illustrate the Kindergarten concepts, each 3" x 3" x 2" (unmounted)	set	1.40
28-7220	GRADE ONE, 9 specimens to illustrate the First Grade concepts, each 3" x 3" x 2" (unmounted)	set	1.40
28-7230	GRADE FOUR, 9 specimens to illustrate the Fourth Grade concepts, each 3" x 3" x 2" (unmounted)	set	1.40

(Schools may purchase emergency supplies directly, paying for same out of the school building's funds. Principals are requested to accumulate receipts of at least five dollars ($5.00) and then make a general requisition (form G1000) to cover the items purchased. Attach all receipts and send the requisition to the Finance Department for reimbursement from the individual school's supply allotment.)